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ANTS' NESTS AND THEIR INHABITANTS.[1]

BY JOHN B. SMITH.

ANTS' nests are found everywhere; in the woods, in the fields, under the stone-walks of cities and in houses. Not only on the ground, but in the trees; and not only in the trunks, but among the leaves. They are as varied in design and general structure as are the localities inhabited, and while some species are content to take advantage of a simple cavity under a stone, where they rear their young; others build great hills full of intricate galleries extending long distances into and under the ground. Volumes have been written on the subject, and many more will be written before either the subject or the public is exhausted. My object this evening is not to speak of the nests of the ants so much as of their inhabitants. These are, of course, primarily the ants themselves, and by disturbing a moderate-sized nest of any of our larger species, the observer will become speedily convinced that the population is not a small one. But not ants alone are found in these nests—there is a very distinct fauna that lives with, and perhaps partly on, the ants, and the species of which are never found elsewhere.

Many hundreds of specimens, principally of Coleoptera, are often found in them, and in Europe nests have been found where the intruders or guests exceeded in numbers the ants themselves. The number of species known to inhabit such nests in Europe reaches well into the hundreds, over a hundred species having been found in a single nest, while in America comparatively few species have been found. There is a reason for that too. Collec-

[1] Read before the Biological Society of Washington, May 29th, 1886.

tors are few anyway, and scientific collectors are very scarce indeed. Besides it requires a good deal of enthusiasm in collecting to attack a large nest of large ants on a warm day when the inhabitants are warlike and capable of inflicting decidedly painful bites, and large colonies are always more prolific both in species and specimens. Collecting thus becomes difficult, and the result is that comparatively little is known of our myrmecophilous fauna. It is too early, therefore, to undertake anything like a complete list of species, and only a brief sketch of what an ant heap often contains is given.

Five groups of myrmecophilous insects can be recognized.

First. Those insects captured by the ants and brought into their nests as part of their source of food supply.

Second. Species found in the nests only in the larval state.

Third. Insects found in the imago or perfect state in the nests, about the larva of which nothing is known.

Fourth. Species often found in ants' nests, but also occurring elsewhere.

Fifth. True parasites on the ants, that feed upon their host or its larva.

In the first group—those insects which the ants collect and care for—the Aphides play an important part. It is well known that the ants seek the plant-lice and lick the sweet excretions; but it is less known, perhaps, that they also collect and rear some species, providing homes for them.

A yellow species of Lasius, occurring commonly in the vicinity of Washington and New York, well illustrates this group. The ants make their nests under large stones and close to the roots of trees or shrubs. They carefully excavate galleries around a root or series of roots, and then collect the winter eggs of a species of Pemphigus in large numbers—not by hundreds but by thousands—eggs that no entomologist has yet succeeded in finding. These are carefully placed in suitable situations around the cleaned root, and the Pemphigus, when hatched, find their food supply ready at hand, and in return are expected to yield sweets to the ants. The winged form of this species leaves the nest and provides for a continuation of the race, and the ants are then compelled to lay in a new supply of eggs.

It would be supposed that the ants would be very careful to keep out all enemies of these, their domestic animals; but there

is one species that gets in and remains in undisturbed. It is the larva of a common "lady bird," *Brachyacantha ursina.* Unlike the larvæ of Coccinellids that prey on arboreal species, this is not brightly colored but sordid whitish-yellow. It is of the usual form of these larvæ, but secretes a waxy substance that exudes in long strings and gives the insect the appearance of being covered with cotton or hoar frost. This secretion seems to be much more palatable to the ants than that of the Pemphigus, and they unconcernedly see the Coccinelid feasting upon the former, apparently concluding that the flavor is improved by passing through the latter. Another larger homopterous species is also found in nests of *Formica integra,* but whether this is used in the same way as the Pemphigus is not known.

Sometimes it happens that a desired species will not live under ground, and this compels the ants to adopt another method, mentioned by Patton some years since. They construct roads to the trees inhabited by the Aphids, and build galleries *around* the plant-lice, effectually protecting and domesticating them.

In this category should come those species of ants which are enslaved by the owners of the nest. The history of that species which captures ants of other species, reduces them to slavery and becomes so absolutely dependent upon its slaves that it perishes from hunger if they are taken away, is well known, and offers one of the most interesting phases of insect economy. It is only mentioned here to complete the category.

The second group, containing those insects found in the nests only in the larval state, is a peculiar one, containing insects of several orders. One of our earliest beetles, *Cetonia hirtipes,* lives exclusively in ants' nests in its larval state; but as imago flies about and feeds on the sweet sap of trees, or in fall upon ripe fruit. In Europe allied species of Cetonia have similar habits. The larva of a group of leaf-beetles (Chrysomelids) have also been found exclusively in ants' nests. In this country the genus Coscinoptera has been so found, and probably the larvæ of several allied genera have similar habits. The imagos have the habits of the other Chrysomelids and are found on leaves.

It is worthy of remark, perhaps, that all these Chrysomelid larvæ thus far found with ants belong to that group which construct hard cases of excrementitious matter for their protection. It would seem that the difference in habit between the exposed

leaf-feeding species and the protected subterranean feeders would have produced either a modification of the sack or have caused its loss in the latter case, but there is no essential difference between those living above and those living under ground.

The odd-looking, spinous larva of Microdon, a dipterous species which has been twice described as a mollusk, is also found here only, while the flies themselves sport in the sunshine as do the others of their kind. A number of other Diptera larva are also found, many of them still undetermined.

Even the Lepidoptera have a representative here, and the larva of *Helia americalis* is found in the nests of *Formica integra* in great abundance.

What purpose these larvæ serve in the economy of the nest, and what they feed on, is a mystery. Why the soft, fat coleopterous and dipterous larvæ are not devoured by the ants, is still to be discovered. The present theory is, that they feed upon the decaying or fermenting vegetable matter in the nest, and being thus useful as scavengers, are tolerated by their hosts. The mature insects seem to be of no use to the ants, and they make no effort to retain them.

The third group, containing insects that are found in the ants' nests in the perfect stage and nowhere else, is by far the most numerous. It comprises species of many orders and of widely divergent families, the Coleoptera being largely in the majority as yet. A few of these true myrmecophilous species have been found in all stages. Mr. Schwarz has found *Euparia castanea* in the nest of *Solenopsis xyloni*, a small ant not one-twentieth of the bulk of its guest, and making small hills only. The upper portion of the hill is sometimes packed full of the beetles, and in the lower stories are found the larvæ.

Most of the species are known in the imago state only, and it has long been and is still a puzzle to entomologists where the immature states of these insects are passed. They are truly myrmecophilous, being found only in ants' nests, and usually confined to a particular species, *i. e.*, a species does not, except in rare instances, inhabit the nest of more than one species of ant. On the other hand each species of ant has its own peculiar fauna of guests, so that it is possible with a series of guests at hand to tell precisely from what ant's nest they were obtained.

These truly myrmecophilous species are again capable of sub-

division into two groups: *a.* Those species from which it is tolerably certain that the ants derive some benefit; and *b.* Those of which nothing at all is known.

The only benefit that is known to be derived by the ants from any of the species is in the shape of a (probably) sweet secretion. Prominent among these are the species of Cremastochilus, most of them of immense size compared to that of the ants with which they live. These insects have a glandiferous surface at the hind angle of the thorax covered with a thin plate, and several specimens have been observed where this plate has been gnawed off by the ants to facilitate their getting at the secretion of the glands. These species, as stated, are of large size, and whole squads of ants have been observed in the task of preventing the escape of an individual that had apparently become tired of its quarters.

This practice of the ants has been but recently discovered, and nearly created a new species. The hind angles of the thorax are characteristic in form, and systematists have used them to separate the species. When the first specimen was found without any angles at all, of course it was thought that here was an entirely new species, and only the fortunate discovery of other specimens in which the angles were only partially eaten off, or missing only on one side, prevented a synonym or two.

There is an immense difficulty in the way of getting at the habits of these inquilines. Not only is it a difficult task in the first place to find them, but when the nests are disturbed everything is thrown out of its usual course, and ants and guests disappear in the same galleries under ground, from which it is impossible to dislodge them. Artificial nests have been constructed in Europe, and it has been observed that the ants appeared to lick certain bristly tufts in Claviger, which have been assumed to be secretory organs. A number of the species in our fauna have similar tufts and they probably serve a similar purpose. They appear in all parts of the body and are very variable in extent. Many species, however, still remain about which absolutely nothing is known, and which have no structures which may be assumed to be secretory. Many years ago it was observed that Claviger was fed by the ants, and more recently Lespes, a Frenchman, confined a nest of ants, and with them some specimens of Lomechusa, a Staphylinid which makes a practice of carrying its abdomen

elevated. He observed that the ants seemed to coax the beetle to lower its abdomen within reach, and whenever this was done they at once pounced on these tufts of bristles which are in this species situated at the base of the abdomen. He fed the ants with sugar and water, and observed in one instance that a beetle approached a feeding ant, made an antennal communication, and that thereupon the ant turned, opened its jaws and permitted the beetle to lick from its mouth the sweets upon which it had been feeding. This observation requires verification, but there is nothing improbable in it.

In the Coleoptera the great family Carabidæ is entirely unrepresented among the Myrmecophili. The Staphylinidæ, on the contrary, have by all odds the largest representation, with the Pselaphidæ closely following. Others of the Clavicorns follow next in order of abundance, while of the other families only occasional representatives are found. It has been observed that in nests where many species are inquilinous the specimens are usually abundant, while those nests containing only one or two species contain also a very small number of specimens.

A number of species of other orders also occur in such nests, but are not sufficiently well determined to admit of reference here. The American ants themselves have never been worked up, and many of the species are still undescribed, and this adds to the difficulty of listing the Myrmecophili.

In regard to habit these species also differ. Some are found only in the main nest, while others are in the van with the advance guard. *Formica* (*Camponotus*) *pensylvanica* inhabits old logs and stumps, and builds long covered galleries from one stump or log to another. In these galleries *Lomechusa cava*, one of its inquilines, is found in the greatest numbers.

If an ant's nest be so disturbed that the inhabitants seek other quarters, the inquilines also leave the spot and follow their hosts, without which it seems they cannot exist for any length of time. Hostile as the ants are as a rule, therefore, to other insects, they yet make a large number of exceptions. Even Eciton, that ferocious ant whose forays Bates has so well described in his "Naturalist on the Amazon," has its inquilines. These ants build no permanent nests but rather temporary camps which they leave at the slightest provocation, and on all their wanderings their inquilines follow them like herds of cattle. This observation has been

but recently made by Wm. Müller, who carefully observed an army on one of its forays.

Some of the ants, which like many species of Formica build over-ground or surface nests, leave their quarters at the approach of cold weather and construct a winter nest some distance off under ground. The inquilines may be found in the old nest for some little time after the ants have left, but eventually they also leave the nest and are supposed to follow: at any rate they disappear. Myrmecophili may be collected at all times, but practically the spring is the only real collecting season. In winter everything is frozen hard and the insects are in the lower galleries and are torpid, or are in the winter nest, which is indiscoverable. In summer the ants are so numerous and so vicious that it is a bold man and a persistent one that braves their attacks long enough to secure a good harvest. The nest must be taken up piecemeal and dumped into a bag to be sifted through a net at the bottom with sufficiently large meshes to allow the insects to fall through. Of course the collector must submit to be nipped in innumerable and often inconvenient places by the enraged ants before he can secure his prizes. It is amusing to watch the rage of these tiny creatures; they run round on the cloth upon which they are sifted, audibly gnashing their jaws, and on the approach of a finger, the forceps or anything else, they rise vertically, with wide open jaws and abdomen curved under the body, ready to nip at whatever comes along. Placing stones in the vicinity of the nest yields some species, but others seem never to leave the galleries, and can only be obtained by destroying and sifting them.

It often happens that two or even three species of ants have their nests under one large stone, and often, too, the Termites, or so-called white ants, have also a colony there. These species seem all to live amicably together so long as they are undisturbed, but when the stone is turned they seem to think that the other species is in some way responsible, and an indiscriminate fight follows. If the Termites are in the field they are the ones that are attacked, and their soft fat bodies offer such favorable points of assault that they are utterly routed and driven into their galleries.

The relation of these true Myrmecophili, upon which no excretory organs have been observed, to their hosts, offers a large and interesting field for study and observation.

The fourth class of guests in ant-hills can be regarded only as visitors. They appear to be accidental inhabitants, just as abundant elsewhere, but not at enmity with the ants and tolerated by them.

The fifth class, or true parasites, comprises certain minute Chalcids belonging, like the ants themselves, to the order Hymenoptera, and a peculiar Stylops, one of the most degraded Coleoptera known. The latter is known only through some parasitized specimens of ants from South America which are now in the British Museum.

That the Chalcids are parasitic is assumed from the habit of the others of the group. So far as I know they have never been actually bred.

The Stylopidæ are, as a rule, parasitic upon wasps, principally in this country, species of Polistes and the occurrence of a species upon an ant is remarkable, for it would seem that the ants would be able to discover the parasite and rid their infested friend of his troublesome guest.

There are a large number of other insects found in ants' nests, such as Acaridæ and Poduridæ, but too little is known of their relation to the ants to allow of their being placed in any of the categories that I have mentioned.

The ant-hill fauna of Europe and North America, so far as the latter is known, run tolerably parallel. Similar genera are found, but thus far only one or two identical species. There are, however, a large number of genera found in Europe of which we have as yet no representatives, and on the contrary we have forms of very striking appearance which are unknown to them.

One other point deserves notice, and that is the remarkable resemblance which the guests sometimes bear to their hosts and the modifications that these species undergo that live with different species of ants. Catopomorphus, when found among black ants, is black; when among red ants is red; when with small species it is small, and with larger species it also increases in size. In shape and appearance the Pselaphidæ offer remarkable resemblances, and it requires a knowledge that the insects are there, and a trained eye, to discover them. Mr. Schwarz informs me that on one occasion when collecting in Florida prairie lands he found *Tapinosoma sessile*, a small dusky ant, in enormous numbers. They were everywhere, and covered all the vegetation.

The beating net seemed to contain nothing but ants. It occurred to him to examine the ants a little more closely, and then some of them turned out to be beetles so closely resembling the ants that they had heretofore entirely escaped the notice of collectors. It is an Anthicid, and is still undescribed. Two species of Temnopsophus were also found which resemble the same ant in a remarkable manner, and a species of Hemiptera mimics it in a curious way.

Ants' nests are therefore something more than the dwelling places of the ants themselves. They are veritable cities, of which the ants are masters and builders, working not eight but twenty-four hours per day, and with inhabitants of many different kinds with very different modes of life, of feeding and of propagating, and all live apparently in the greatest harmony.

It remains only for me to acknowledge the source of much of my information concerning ants and their guests. Mr. E. A. Schwarz, of the Department of Agriculture, has probably the largest experience of any American collector in searching ant-hills, and his collection of Myrmecophili is probably the finest. He is as liberal with information as he is with specimens, and I take pleasure in admitting that his information and his collection have been freely drawn upon by me.

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GEOGRAPHICAL AND GEOLOGICAL EXPLORATION IN BRAZIL.

BY JOHN C. BRANNER, PH.D.

WHEN the Imperial Geological Survey of Brazil, under the late Professor C. Fred. Hartt, was suspended, geological work in that empire came to a standstill. After the death of Professor Hartt, Professor Derby, the senior assistant on the survey, was, after a good deal of delay, appointed director of the geological section in the National Museum, in charge of which the extensive collections of the survey had already been placed.

Professor Derby has remained in Brazil ever since, and has succeeded in turning to good account much of the material and work of the old survey. The general government, however, has done but little to encourage geological work—nothing, in fact, except to retain Mr. Derby in his place in the museum, and thus to enable him to accomplish something.

But this want of encouragement is not necessarily due to a lack of appreciation of or interest in such work on the part of the prominent statesmen of the country, but rather to the financial condition of the empire, which is somewhat embarrassed by various causes, prominent among which is the gradual disappearance of slaves and consequently of the labor element.

Recently the province of São Paulo has undertaken certain explorations within and along its own borders, which, it is to be hoped, will add much to our geological knowledge of that part of Brazil.

The survey that was inaugurated in that province in May of the present year was projected by the distinguished and able senator from Pernambuco, J. A. Correia de Oliveira, popularly known as João Alfredo, who was president of the province of São Paulo until about the 1st of May.

His original object was a study of the navigability of the Rio Paranapanema, a large stream forming the boundary between the province of Parana and that of São Paulo, and the making of a physical and itinerary map of the province.

The president asked Mr. Derby's coöperation in this work. Mr. Derby, however, told the president that he could only undertake such work in connection with a geological survey. The plan was therefore modified accordingly.

It can best be given in the words of the president of the province in his report to the provincial assembly. As this report shows how far-reaching the influence of our own geological surveys has been, as well as the objects of this survey, I quote it at some length. The president says:

"The plan proposed by Mr. Derby, and which I have the honor to commend to your attention, is essentially the same as that adopted by the late Professor Hartt for the work of the Imperial Geological Survey, and is based upon the methods evolved, after many years' experience, by the geographical and geological surveys of the United States, and which, in view of their rapidity and economy, are the most appropriate for regions in which large and thinly settled areas have to be explored. He contemplates making maps upon a scale of one centimeter to a kilometer, which will show at once the geography, topography, roads, geology and agriculture, and on which will be located cities, factories, surface characters, railways, wagon roads, streams, mines, etc., and the geology, the distribution of land adapted to agriculture and to cattle raising, and that which is unproductive.

"The maps will be accompanied by reports describing the physical features of the province, the geological structure, the agricultural and mineral resources, meteorology, hydrography, including the study of our navigable streams and the means of improving them, the quality of the soils and the natural conditions favorable to industry, etc.

"This plan is perfectly practicable within a reasonable length of time, as experience in the United States has shown, if we count upon the rapidity with which American geographers worked. The *personnel*, if limited to four professionals, will require ten years to complete the map of the whole province, the annual expenses being limited to a score or two of contos.[1]

"The estimate for the expenses of the first year, including the purchase of instruments and the beginning of operations, will not exceed fifty contos ($22,000), and it is to be presumed that it will be advisable to reduce this amount in future years. The results of the labors of the first year will enable the authorities to appreciate the practicability and utility of the plan proposed, and to judge of the convenience of continuing it either under the same organization or upon a more extensive scale.

"It seems most urgent that we should first have information concerning the southern part of the province in order to throw light upon the feasibility of connecting our railway system with the navigable parts of the River Parana and its tributaries by way of the Paranapanema, a connection which was regarded by the Visconde do Rio Branco and by Buarque de Macedo and others as the best road to Matto Grosso. For this reason it seems best that the work should be begun in this region and should include the question of the navigability of the Paranapanema. According to this method the work of subsequent years should be carried on in districts selected with a view to meeting public requirements until, by the coördination of the work of each year the whole province shall have been examined."

The bill appropriating fifty contos ($22,000) for the work of this survey was passed almost unanimously by the provincial assembly, and Mr. Derby began the work of organization about April 1st.

The corps, with the exception of Mr. Derby himself, is made up entirely of Brazilians. The engineer in charge of the geographical work is Sñr. Theodoro Sampaio, who was at one time an assistant of Col. Milnor Roberts in his explorations of the Rio São Francisco, and of whose ability and fidelity Col. Roberts had a high opinion.

Two young graduates from the Brazilian School of Mines at

[1] A conto of reis, at the prevailing rate of exchange, is $440.

Ouro Preto have been selected as the geologists, Sñr. Campos and Sñr. Oliveira. Mr. Derby will remain in Rio de Janeiro and direct the work from there.

The survey has been received with enthusiasm in the province of São Paulo, and it is hoped that Mr. Derby may succeed in keeping this enthusiasm alive.

In view of the treatment of Professor Hartt and his works by the Brazilian Government, most scientific men may be somewhat skeptical as to whether the Brazilians have the patience necessary to carry on, even for ten years, a work from which they expect results more striking and more tangible than purely scientific ones. Much however is to be hoped for from the intelligent Paulistas. Theirs is the great coffee region of Brazil, the wealthiest and most enlightened province in the empire. The soil is fertile, the climate is remarkably fine, the people educated and the very types of hospitality. There is every reason then to hope for valuable results from the work begun. It certainly is undertaken in the most promising part of the empire, and is in the hands of the man, who, by more than ten years' residence in that country and by acquaintance with the people and the geology, is best fitted to carry it to a successful issue.

POSTSCRIPT.—Since the above was written the definite instructions, given by the provincial assembly regarding the work of the commission, have been received. The following, quoted from these instructions, will give a further idea of what is to be expected of these explorations:

"Besides the geodetic and geographical work, collections will be made and information obtained, as far as possible, concerning the various branches of natural history, special attention being paid to the practical and economic relations of zoölogy and botany; to industry and agriculture; to animals and plants—both noxious and beneficial; to the conditions of the various branches of industry in the different parts of the province; to the diseases peculiar to cultivated plants and domestic animals, together with the means employed for abating these evils.

"While the commission is not supplied with the requisite *personnel* for services of this character, the chief may obtain the services of specialists either within or without the empire, sending them collections for determination or examination, or for any purpose interesting to science.

"The collection shall be accessible to the public, and shall form the nucleus for a provincial museum."

The field party left Itapetininga, Province of Sao Paulo, on the 25th of May, to begin the explorations of the Rio Paranapanema.

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CROW ROOSTS AND ROOSTING CROWS.

BY SAMUEL W. RHOADS.

BY no means the least interesting topic in the life-history of *Corvus americanus* is that which relates to the roosting habits of this familiar and persecuted bird during six months of the year.

Throughout the breeding and rearing period which, in the Middle States, is almost cotemporary with the spring and summer months, the crow is not a gregarious bird, differing in this particular from its lesser kin, the blackbirds, which are eminently gregarious throughout the year; but as autumnal changes alter the face of nature and usher in new aspects of environment, the flocking habit becomes universal and the scattered families unite by common consent from the four quarters of their dispersion. The most casual observer cannot fail to remark the phenomenal increase in apparent number of crows in this latitude on the approach of winter. We may not account for this by referring it to the mere fact that flocking birds *seem* more numerous than they are in reality, nor is it possible that the immense assemblage of crows in the vicinity of Philadelphia during the winter season is composed solely of birds resident in the States of Pennsylvania and New Jersey. In the face of plain evidence to support such a conclusion, ornithologists generally ignore the fact of crow migration.

Undoubtedly the increase of crows at this season is largely due to accessions from the New England and Western States which join the thousands assembled from the interior of our middle districts. This migration, though "partial" and in some degree influenced by the comparative severity of winters, is none the less a typical one, a necessary provision for their self-preservation and a prime factor in the struggle of existence, even in a bird whose hardihood and tenacity of life have become almost proverbial.

Careful observation and inquiry convinces me that during winter a radial sweep of one hundred miles, described from the city of Philadelphia and touching the cities of New York, Harrisburg and Baltimore, will include in the day time, in its western semicircle, fully two-thirds of the crows (*C. americanus*) inhabiting North America, and *at night* an equal proportion in its eastern

half. The eastern area of this circle, with the exception of more fertile portions of West and North Jersey, is as notably devoid of them by day as it is infested by them at night. Their most extensive breeding grounds in New Jersey are well-nigh deserted during severe weather.

The popular local notion that crows all "go to Jersey to roost" and return to Pennsylvania to forage, while far from correct, has more truth in it than the average Jerseyman will admit.

The pine barrens and swamps of the interior afford but scant subsistence in winter, though providing ample summer accommodation to thousands, while on the other hand, the cultivated and more fertile portions of Delaware, Maryland, East Pennsylvania and West Jersey present an abundant winter supply of foodstuffs.

Another important factor in their choice of this district as a winter resort can best be understood by reference to the map, where it will be seen that nowhere on the Atlantic coast are the geographical conditions, both physical and climatic, more favorable to a supply of animal and vegetable food than in the four southernmost Middle States, whose wealth of bays, rivers, creeks and estuaries is unsurpassed in the United States.

The main object of this paper shall be to give a description of their nightly rendezvous, or "roosts," at this season of year in the afore-mentioned districts, adding thereto such deductions as are presented by a study of the history of such places, together with observations respecting the habits of crows before and after assembling at their roosting grounds.

It should be borne in mind by those unacquainted with the locality described, that it not only is preëminently a good feeding ground, but that it also furnishes, in the evergreen forests which skirt the shores of Delaware and Chesapeake bays and their numberless tributaries, a no less suitable shelter wherein to pass the night.

The literature of crow roosts is scant, modern ornithologists having virtually kept silence respecting this interesting phase of bird-life.

Wilson's description is probably the first published one available. It is as follows:

"The most noted crow roost with which I am acquainted," says he in his American Ornithology, "is near New Castle, on an

island in the Delaware. It is there known by the name of the Pea Patch, and is a low, flat, alluvial spot of a few acres, elevated but little above high-water mark and covered with a thick growth of reeds. This appears to be the grand rendezvous or head-quarters of the greater part of the crows within forty or fifty miles of the spot. It is entirely destitute of trees, the crows alighting and nestling among the reeds, which by these means are broken down and matted together." He continues: "The strong attachment of the crows to this spot may be illustrated by the following circumstance: Some years ago a sudden and violent north-east storm came on during the night and the tide, rising to an uncommon height, inundated the whole island. The darkness of the night, the suddenness and violence of the storm and the incessant torrents of rain that fell, it is supposed, so intimidated the crows that they did not attempt to escape and almost all perished. Thousands of them were seen next day floating in the river, and the wind, shifting to the north-west, drove their dead bodies to the Jersey side, where for miles they blackened the whole shore. This disaster, however, seems long ago to have been repaired, for they now congregate on the Pea Patch in as immense multitudes as ever."

This account refers to some period in the last decade of the eighteenth century. In a foot-note to this we have the following, which appeared in a newspaper of the locality about the year 1800: "The farmers of Red Lion Hundred held a meeting at the village of St. Georges, in the State of Delaware, to receive proposals of John Deputy on a plan of banishing or destroying the crows." * * *

"Mr. Deputy proposes that for $500 he will engage to kill or banish the crows from their roost on the Pea Patch and give security to return the money on failure." I am unable to find any other account of this remarkable roost, and am tempted to suppose that Deputy accomplished the herculean task and outdid the tempest and the deluge. Pea Patch was deserted long ago, *how* long it seems impossible to determine, but for the present I shall defer further comment on it to a future page and return to the literature of roosts in general.

Audubon relates, in his "Biography," a few particulars respecting the roosting of both species of crow (*C. ossifragus* and *C. americanus*), which appear as much based on Wilson's observa-

tions as upon his own experience. They are as follows: "At the same season (autumn) they (crows) retire in immense numbers to roost by the margins of ponds, lakes and rivers, covered with a luxurious growth of rank weeds or cat-tails. They may be seen proceeding to such places more than an hour before sunset, in long, straggling lines and in silence, and are joined by the grackles, starlings and reed-birds, while the fish-crows retire from the very same parts to the interior of the woods, many miles distant from any shores."

In his "Manual" we find Nuttall quoting from Wilson's account, adding thereto additional information of a roost on Reedy island, in the River Delaware.

By far the most complete and reliable account of the roosting habit of our crow is to be found in a little work entitled "Rambles of a Naturalist," by Dr. John Godman, who at one time filled the chair of anatomy at Rutger's College.

Godman resided, about the year 1825, as country physician in Anne Arundel county, Maryland, which place afforded him ample opportunity for observing every phase of crow life throughout the year. Perhaps the best introduction I can give to the crow-rally or "round up" which always precedes their final bivouac for the night, will be in his words:

"About a quarter of a mile above the house I lived in, on Curtis's creek, the shore was a sand-bank or bluff twenty or thirty feet high, crowned with a dense young pine forest to its very edge. Almost directly opposite the shore was flat and formed a point extending in the form of a broad sand-bar for a considerable distance into the water, and when the tide was low this flat afforded a fine level space to which nothing could approach in either direction without being easily seen. At a short distance from the water a young swamp-wood of maple, gum, oaks, etc., extended back towards some higher ground. As the sun descended and threw his last rays in one broad sheet of golden effulgence over the crystal mirror of the waters, innumerable companies of crows arrived daily and settled on this point for the purpose of drinking, picking up gravel and uniting in one body prior to retiring for the night to their accustomed dormitory. The trees adjacent and all the shore would be literally blackened by those plumed marauders, while their increasing outcries, chattering and screams were almost deafening. It certainly seems that they derive great pleasure from their social habits, and I often amused myself by thinking the uninterrupted clatter which was kept up, as the different gangs united with the main body,

was produced by a recital of the adventures they had encountered during the last marauding excursions. As the sun became entirely sunk below the horizon the grand flock crossed to the sand-bluff on the opposite side, where they generally spent a few moments in picking up a further supply of gravel, and then arising in dense and ample column they sought their habitual roost in the deep entanglements of the distant pines."

Dr. Godman, after describing some of the methods employed by professional crow-hunters to secure these outlawed birds because of the price set on their heads by the State of Maryland during the years 1800 to 1804, inclusive, continues:

"But the grand harvest of crow-heads was derived from the invasion of their dormitories, which are well worthy a particular description and should be visited by every one who wishes to form a proper idea of the number of these birds that may be accumulated in a single district. The roost is most commonly the densest pine thicket that can be found, generally at no great distance from some river, bay or other sheet of water which is the last to freeze, or rarely is altogether frozen. To such a roost the crows which are, during the day time, scattered over perhaps more than a hundred miles of circumference, wing their way every afternoon and arrive shortly after sunset.

"Endless columns pour in from various quarters, and as they arrive pitch upon their accustomed perches, crowding closely together for the benefit of the warmth and shelter afforded by the thick foliage of the pine. The trees are literally bent by their weight, and the ground is covered for many feet in depth by their dung, which by its gradual fermention must also tend to increase the warmth of the roost. Such roosts are known to be thus occupied for years, beyond the memory of individuals, and I know of one or two which the oldest residents in that quarter state to have been known to their grandfathers, and probably had been resorted to by the crows during several ages previous. There is one of great age and magnificent extent in the vicinity of Rock creek, an arm of the Patapsco.

"They are sufficiently numerous on the rivers opening into the Chesapeake, and are everywhere similar in their general aspect.

"Wilson has signalized such a roost at no great distance from Bristol, Pa., and I know by observation that not less than a million of crows sleep there nightly during the winter season. To gather crow-heads from the roost a very large party was made up, proportioned to the extent of surface occupied by the dormitory.

"Armed with double-barreled and duck guns which threw a large charge of shot, the company was divided into small par-

ties, and these took stations selected in the day time so as to surround the roost as nearly as possible.

"A dark night was always preferred, as the crows could not, when alarmed, fly far, and the attack was delayed until full midnight. All being at their posts, the firing was commenced by those most advantageously posted, and followed up successively by the others as the affrighted crows sought refuge in their vicinity. On every side the carnage then raged fiercely, and there can scarcely be conceived a more forcible idea of the horrors of a battle than such a scene afforded.

"The crows screaming with the fright and pain of wounds, the loud, deep roar produced by the raising of their whole number in the air, the incessant flashing and thundering of the guns and the shouts of their eager destroyers, all produced an effect which can never be forgotten by any one who has witnessed it, nor can it well be adequately comprehended by those who have not.

"Blinded by the blaze of the powder and bewildered by the thicker darkness that ensues, the crows rise and settle again at a short distance without being able to withdraw from the field of danger; and the sanguinary work is continued until the shooters are fatigued or the approach of daylight gives the survivors a chance of escape. * * * *

"During hard winters the crows suffer severely and perish in considerable numbers from hunger, though they endure a wonderful degree of abstinence without injury. Multitudes belonging to the Bristol roost perished during the winter of 1828–9 from this cause. All the water-courses were solidly frozen, and it was distressing to observe these starvelings every morning winging their weary way towards the shores of the sea in hopes of food, and again to see them toiling homewards in the afternoon apparently scarce able to fly."

This vivid portrayal leaves nothing to be desired in a description of roosting places in Maryland at that time. Let us now turn from this glance at the past, to a consideration of the present history of crow roosts in the Middle States.

My inquiries and correspondence regarding the Pea Patch roost, so far, result in nothing of interest further than the bare fact of the crows not having used that island within the memory of those whom I have addressed, nor have they even so much as heard of this roosting place, but all referred to Reedy island as being the only like resort in the locality.

Nuttall, referring to the subject, writes: "Whether this roost (Pea Patch) be now occupied by these birds or not, I cannot pretend to say, but in December, 1829, I had occasion to observe

their arrival on Reedy island, just above the commencement of the bay of that river (Delaware) in vast numbers."

One correspondent states that since the erection of Fort Delaware it would be impossible for crows to find a night's lodging on Pea Patch. Fortifications were begun there in the year 1814, and in 1860 the fort was greatly strengthened and became for the first time a place of importance. Summing up these facts I am led, in the absence of direct evidence, to believe that this noted roost was abandoned soon after the construction of Ft. Delaware was begun in 1814, and that the crows betook themselves to Reedy island as the most convenient substitute.

John Deputy's plan, whatever that was, of banishing the crows from their favorite island may have been successful ere the place became Ft. Delaware, but in case of his probable failure we may safely suppose an idle garrison of United States troops were not slow to improve their peculiar opportunities for rifle practice and midnight massacre on these feathered aborigines.

So far as my inquiries have gone, I find that here is an anomaly confined to two small islands in the River Delaware, which, for years unnumbered, have been the nightly resort of crows. We cannot assert that Reedy island was not used for roosting purposes in the time of Wilson, but it seems probable that we should have heard from him regarding it had it been so frequented, as the two places are but seven miles apart.

Such islands are not confined to the waters of the Delaware; why then such departure from a general rule in favor of using them alone? The reeds afforded a miserable substitute for pine boughs, and when they became broken down by the numbers accumulated upon them, we may well picture the misery of roosting on a mud flat in winter with the snow a foot deep.

The utter contrast between roosting on a reedy flat wholly devoid of other vegetation and subject to sudden inundation by the tide, and going to bed among the dense pine forests of New Jersey, is evidently beyond the comprehension of a crow, and may well tax the imagination of an uninformed man.

Mayhap in the first decade of the seventeenth century, ere Hudson had discovered Delaware bay, and when freshets, neap-tides and pale faces were not, crows may have rejoiced to get foothold for a night's rest on the peaceful shores of Pea Patch

island and to sleep secure from the nocturnal prowlers of the mainland pines.

To this decade we must revert for reasons which could not agree with the advanced civilization of a later century. But while we may account thus for the original impulse, wherefore should there be such provincialism among a few when there was ample chance and territory for the many to do likewise?

Were the Pea Patch and Reedy island crows Spartans or Helots in the corvine commonwealth? Did they transmit their predilections from father to son, or was caste determined by the query: "How do you roost, on Pea Patch island or in a tree?"

This may seem as mere child's prattle, yet it is worthy of serious conjecture, to say the least, whether sectional family traits are transmitted and obeyed by succeeding generations with as blind devotion and prejudice in birds as in man himself. Indeed, instances of heredity in tastes and anomalous predilections in the brute world are frequent and indisputable facts. As to their continuance through time until distinctive traits become gradually of generic consequence, we may well defer conjecture and await a more decisive answer in the future developments of scientific research.

Apropos of this question we may just here consider another, not wholly dissimilar, relating to the subject in hand and, as will be seen, involving the general principles of migration.

My residence is situated exactly in the track of the principal flight of crows which fly, evening and morning, to and from their roost, five miles distant and which is located near Merchantville, Camden county, New Jersey.

On a windy evening the birds fly very low, as they pass over open fields nearly brushing the surface of the ground with their wings.

On the west side of the house stretches a belt of woodland separated therefrom by an open field which the crows always traverse in their eastward course at night. This woodland is narrow, and as they approach its western boundary each crow elevates its flight sufficiently to pass among the tree-tops, and then immediately descends to a former level on reaching my field of observation. Birds therefore advancing on the farthest side of the wood cannot be seen nor can they see the course of those traversing the field.

One afternoon, it being very tempestuous, I stood by an open window to shoot the crows as they toiled past, but finding that effort fruitless, I sought more profitable diversion in watching their manner of flight. They appeared in long, straggling lines which were often separated by a distance of a quarter or half mile, and came along in detachments, each of which, as is always the case in such weather, maintained the utmost silence.

Having observed that the line taken by a certain detachment was not more than twenty feet in breadth, and that the whole company passed between certain shocks of corn, I felt curious to see the course of the next, which as yet had not appeared above the tree-tops. After the lapse of half a minute a solitary crow appeared, closely followed by three more, and all in like manner and with the common consent of a pack of hounds on the hot trail, pursued the invisible course of their predecessors among the trees, closed their pinions and stooped, as the others had done regardless of the buffeting winds, to the self-same track across the corn-field, and followed it. If every stone and shock and corn-stub had been a finger-post to mark the path of company A to Merchantville, those four sable pilgrims of company B could not have traversed "the desert and illimitable air" with more undeviating certainty nor have had a more unerring foresight of that Mecca of their weary hopes. Long did I watch this mysterious phenomenon, till darkness drew the veil. In miniature, thought I, have I seen a great and mystic phase of nature; migration in a nutshell. Now that we have something tangible to hammer at, let us seek the power and means to crack it and extract that kernel, long coveted by man; contented no longer to assign the honor of cracking such to a "future generation." A pack of hounds, closely following the scent, presents a tangible relation to the mind. We can conceive of an odor that touches earth and of olfactory powers sufficient to trace it thus, though we ourselves possess them not; nay further, we can comprehend the canine ability to scent, through sole medium of the atmosphere, across trackless districts and great distances, and now-a-days we should no longer hesitate to ascribe similar powers to vulturine birds, which in addition possess a wondrous gift of vision. May we deny the *latter* to the crow or dispute that the *former* sense is not only of every-day use to him (though in a modified degree)

but also to all birds. Not that I would infer that power of *scent* is of any considerable value in the migration of birds, nor would it be fair to assume that unaided vision is more than a prime factor therein.

'Tis mortal to take our observations from a human standpoint and refer all that goes beyond *human* attainment in the lower animals to "instinct."

Research in natural science as long since paid full penalty for her sins in this purgatory of original thought, and the time has fully come for us to advance into a higher sphere, querying the "what" and the "why" in the Emersonian assurance that "undoubtedly we have no questions to ask which are unanswerable." Phrenologically considered the crow has an excessive "bump" for locality in one corner of his wonderful memory, and size, color (?), form and calculation cluster about his knowing eyes. No less than Audubon long ago professed to have discovered that a crow can count five. Have modern ornithologists done as much?

Be this as it may, we have in our corvine methods of flight an important premise for the final understanding of the laws governing migration and of the so-called migratory "instinct," which is nothing more or less than the highly perfected sense or union of senses which enables migrants to traverse tracts of territory (which the uncultured, imperfect mind of man calls illimitable) with a precision which equals that of the wandering crow in finding its roost, or which a man exercises on a still smaller scale in the streets of his native town.

A North American Indian can form a far bètter conception of migration than a Yankee could, inasmuch as the former is by all odds the better explorer of trackless forests and boundless prairies. Would we have a "bird's-eye view" of this subject? Then by all means let us "take wings of fancy and ascend" to a point without the earth, though it be merely to understand how a place may be so far off "as the crow flies."

As yet our unfaith in aërial conquests has kept this inquiry of economic ornithology at a stand-still; but the spirit of Darius Green is again at work; may its leaven work mightily in the efforts of the A. O. U., through its committee on bird migration.

As yet no evidence is at hand to justify the supposition that the roosting place which Wilson and Godman have vaguely de-

scribed as situated " near Bristol " was in Pennsylvania. It seems more probable that it was located either on Burlington island or on the mainland near the site of the city of Burlington, in New Jersey.

Twenty years ago a colony of crows roosted on Newbold's island in the Delaware river, four miles north-west of Burlington island, and forty or fifty years ago another colony slept in a wood near Florence and, being disturbed, moved to another forest near Beverly which, within three years, has been deserted in turn for another site.

There is much to warrant the conclusion that the great roost described by Wilson was parent to this and many others now scattered over Burlington county, New Jersey.

(To be continued.)

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THE WINGS OF BIRDS.

BY I. LANCASTER.

WHILE engaged in ascertaining the methods employed by the soaring birds, on reaching a point where light began to break upon the obscurity, it became evident that the flight of all birds would be made comprehensible; that not only the day-long translation of frigate birds in circular paths high in the air, but the homeward passage of pigeons and the migratory flight of wild fowl, would emerge from the realm of fancy and range themselves with allied phenomena on the platform of recognized mechanical activities.

Indeed, many specimens of active wing flight have hitherto as completely baffled the best efforts of mechanical science as has soaring flight. When the weight of the bird is considered as resistance to be overcome by muscular force, flapping is incompetent to do the work required, and in spite of such effort gravity would compel motion in its own direction to the surface of the earth. The area of the two wings of a duck of four pounds weight, which is effective on the air in the down stroke is not more than two square feet. Counting one up and one down vibration as a single stroke, not more than three of these would be made in one second, and a liberal estimate would be an average of one foot of space traveled at each stroke for the entire wing surfaces. This ignores loss in the upward vibration. The effective work done on

the air would therefore be equal to that of two square feet of surface moving at right angles to itself at the rate of three feet per second. Turning to Hutton's tables we find that a wind of about thirty feet per second is required to furnish a normal pressure of two pounds on a plane of one foot square, so that if the wings of the duck were supposed to be rigid, and the motion a continuous fall, uniformity would not be reached under a velocity of thirty feet per second. If this velocity be transferred to the wing vibration, stability of the body could only be secured by a rapidity of stroke ten times as great as what actually occurs. But when we add the air resistance to lateral motion of, say one hundred miles an hour, measured by air passing the bird, its muscular exertion becomes still more incompetent to effect the result, for now a portion of the energy which before was used to antagonize gravity must antagonize air resistance.

Further load is thus added to the working force, which before was hopelessly incompetent to its task. No method which is supposed to differ from the direct motion will assist in the least. It is velocity which is wanting. As there can be no shorter line between two points than a straight line, so there can be no more effective method than continuous motion, normal to the surface, with no change whatever in the character of the activities. A continuance of the maximum is the height of effectiveness. No screw motion, or wave motion, or figure-eight motion, which the wing may imitate, can produce results as good as the direct motion.

But bird flight thus conceived does not exist in nature. As a fact, gravity is not resistance but motive power. The bird is a machine doing work on air under the dominion of that force. The work done is not the sustained bird but the quantity of air disturbance which falls to an equilibrium with the surrounding atmosphere after the passage of the moving body through it. Gravity is not resisted, it is resolved. The bird is constantly moving in the direction of the normal component with a uniform velocity which develops air pressure sufficient to neutralize the component acting in the plane of the wings and the additional surface friction of the air. The direction of the fall is that of the gravity of the bird's mass, and this direction changes with the slant of the wings, being always at right angles thereto in obedience to the law of fluid pressures. The fall is always away from

the plane of the wings, or the bird's horizon, so that no weight is lifted in the lateral motion, as the body is continually descending on its own vertical. This view completely transforms the aspect of atmospheric navigation, and brings order out of chaos.

I have hitherto spoken of the expansion of the compressed air in the rear of the wings producing the thrust needed for the lateral motion. This was done to avoid complicating the case. The significant thing is the resolution of gravity and consequent shifting of the vertical, and if this fact is seen the method of utilizing the pressures presents no difficulty.

I now wish to direct attention to the structure of a bird's wing. The wing of a pigeon or any of the barnyard fowls may be examined, as the peculiarities I desire to point out are found in all of the large birds. First, let us examine a feather. If we place one on the table with the lower surface upwards and pass the hand from the quill to the tip, it will seem smooth to the touch, while reverse motion meets with much roughness, which increases as the pressure of the fingers becomes greater. If a small tube be taken into the mouth and the breath blown quite slanting towards the tip, the feather will remain smooth and the air slip over it easily. In the reverse direction the blast will tend to open the ribs and increase the roughness. The feather is a little like a cat's back; a rub toward the rear is pleasant to all parties, while one the other way tends to cause motion of the animal to the front. Notice also that the tip is very thin and elastic, yielding in a graceful curve to slight pressure. The surface of the wing is composed mainly of these feathers, having their general direction across, with the tips to the rear. They are held by the integument covering the bones of the wing, which are located on the front edge, and while on the upper front side the curve is smooth and regularly rounded, beneath there is a projection downwards of the skin, which forms a ledge reaching along the humerus to the elbow and thence to the junction of the ulna and radius with the bones of the wrist, being greatest at the elbow. In the soaring birds this ledge is largely developed, projecting downwards in the frigate birds one and one-half inches at the elbow, tapering to the wrist and body. This ledge, at the front edge of the wing, seems at first view to be an obstruction to flight, as it makes considerable thickness where the surface first meets the air, but, as we shall presently see, it has an important

function to perform as a member of the organized mechanism of flight. The curves in the plane of the wing need not be considered as they are not concerned with flight, and when the bird is in the act of flying they are straightened out so that the wing assumes a plane shape. The above four peculiarities we desire to note. Firstly, that the wing is practically a thin plane. Secondly, that its rear edge is very pliable and elastic. Thirdly, that its under surface is rough to motion from rear to front but smooth to motion from front to rear. Fourthly, that it is supplied with a ledge along its under surface at the front edge.

Let us now attend to a matter of simple experiment, which demonstrates bird flight as I have presented it in the pages of this magazine, and which connects the above-described construction of a wing, which is the organ of flight, with the mechanical forces which are operative upon it. A few cents' worth of material and the expenditure of a little time is required, which, coupled with a minimum of mechanical expertness, will suffice. The movements following changes made in the plane are so prompt and emphatic that there is no mistaking them.

If we take a sheet of light, strong paper, such as goes into the construction of fireworks, and stretch sixteen by forty inches of it tightly on thin strips of bamboo, so as to present a plane surface on one side, and fasten a four-ounce weight in the center beneath by threads to the four corners, we will have a miniature parachute. By putting its upper surface against the ceiling and permitting it to fall, it will descend vertically if we have it well balanced. It is obvious that the entire column of air from the ceiling to the floor is moved out of the place it occupied by the fall of the plane upon it. It is evident that the pressure of the plane against the air is greatest in the center, diminishing to the edges where it is nothing. Hence the zone of air under the plane, acted upon by it, would be pyramid-shaped with a base sixteen by forty inches, a top line twenty-four inches long and a height varying with the velocity of the fall of the plane, with the apex pointing downward, and there would be a steady flow or slipping of the compressed air along the surface in all directions from the center. This slipping would cause friction on the surface, which being alike in all directions no lateral motion would occur. If we now take some large-grained, light sawdust and mucilage, and thinly sprinkle one-half of the under surface from one of the long edges

to the center, the level plane will no longer fall vertically but move towards the edge bounding the sawdusted half. If we extend the paper an inch over the edge opposite the sawdust and snip it into the bamboo so that it will curve upwards, we shall find on dropping the plane that its sideways motion will be augmented. If we paste a slip of paper to the front edge, allowing it to project one and one-half inches beneath, we shall find the sideways motion to be further increased so as to be many times that of the fall. If we take the plane to the housetop when the air is calm and allow it to drop, it will describe a curve while it is being accelerated, but on uniform motion occurring it will slant downwards very gently and move laterally from six to eight times as fast as it falls vertically. This experiment is very delicate and the motion varies greatly, depending on the weight and humidity of the air and the construction of the plane. The cause of this behavior is obvious. The air in rushing along the under side of the plane to escape, drags the rough surface with it to the front, slipping over the smooth part to the rear easily. Then as it turns the curve it expands against it, augmenting the front thrust. Where the air escaping toward the front meets the ledge, a complete stoppage occurs, and the thrust against it is quite violent. The ledge in front of the roughened half of the surface, and the rear curve, all tend to throw the plane edgeways in the same direction while it falls. The ledge by directly stopping the motion of the rushing air; the rough surface by frictional resistance, and the curve by presenting a base for the compressed air to expand against. The force required to produce these various results is put into the air by the descent of the plane upon it under the impulse of the gravity of its mass. The wing of a bird would act in the same way that the plane acts, and for the same reason. The elastic feather tips give the curve. The construction of the feather surfaces gives the smooth rear and rough front part; and the front projection of the integument covering the bones forms the ledge.

Why is it that the plane moves so much faster edgeways than it falls? Obviously because the condensed air in contact with the surface moves with far higher velocity than the fall, carrying the plane with it. The inertia of the air resists sudden motion so that the particles are compressed before they begin to move,

and when motion at length occurs, it is sufficiently rapid to make up for lost time. A non-elastic fluid would not present this rapid motion on the compressing surfaces. If we increase the pendant weight and take the plane to the lantern of a lighthouse, or very high building, we shall find that its lateral motion will be greater, and every addition of weight will heighten the lateral velocity in a greater ratio than the fall. The reason is that the plane meets with small resistance to its edgeways motion, so that a slight increase of force in this direction moves it rapidly. But however great this motion may be, however closely it may approach level translation, by no means could it become horizontal as long as the plane itself was level. The entire force producing lateral motion comes from motion in the direction of gravity down the vertical, and horizontal translation would stop the fall, thus cutting off the motive power. But if we slant the plane the vertical goes over with it. Its own activity determines the direction of its vertical. It is fluid pressures we are dealing with, and what would be level translation on our horizontal is a constant fall from the bird's horizontal, and a soaring bird certainly needs no further explanation, neither does a wild duck. It is not heavy enough relatively to the size of its wings to reach a uniform velocity of fall which would produce the thrust needed in the lateral motion, and resort to flapping is compelled to aid the normal component of gravity. The wing now comes down with velocity sufficient to give the thrust required for horizontal flight. But both soaring and flapping would be impotent without the resolution of the direction of gravity.

The moment the plane is inclined it becomes necessary to counteract the component of resolved gravity acting in it, on the downward slant, and this component carries the plane with it during acceleration to the ground before uniform motion occurs. The application of external force to the plane, reversing its motion, is attended with difficulty on account of the rapidity of its movements and the inertia of the pendant weight. All the impulses must be steady, jolting motion being fatal to success. Care must be taken in carrying our experience of velocity derived from other things into this region. It is not likely that a vigorous man could move his limbs at a higher speed than thirty-five feet per second for a short time at his utmost exertion. These planes greatly exceed this velocity in the lateral motion, the

soaring birds moving at times at the rate of 150 feet per second.

Motion of the planes, therefore, is best derived from their own activities. This can readily be obtained in still air by using fine shot for the weight in an oil-silk bag with a thin neck opening into another placed lower and fastened to the corners of the plane by separate strings. The neck should be made to allow two pounds of shot to flow through it in about ten seconds; as the shot reached the lower bag the plane would be slanted by drawing on the longer front and shorter rear strings.

With 150 feet fall this construction will give motion under the resolution beautifully. Nothing can exceed the graceful curvature of its movements excepting similar ones made by the soaring birds. As acceleration passes into uniformity and the total force is expended in the work on air, as the shifting balance inclines the plane transforming the vertical, ample force is on hand in the condensation to resist the downward slanting impulse. If the adjustment is correct, holding the plane on the right incline, horizontal motion will occur until it passes out of sight. More inclination will cause upward slanting direction. If the incline be so great as to throw too much of the resolved gravity into the plane for the forward thrust to cope with, speed will slacken and finally motion to the front will cease and be reversed on the downward slant backwards, and the frail machine become a wreck in an instant by violently striking the earth. I have floated these planes from the lantern of Egmont light at the entrance of Tampa bay, on the Gulf coast of Florida, when the air was so still that a handful of down, from the breast of a pelican, thrown from the top would quietly sink along the shaft to the ground.

To one who is familiar with the soaring birds, and has made a study of their habits, these floating planes present little that is interesting. They imperfectly imitate the birds and do nothing that the birds can not do better. The latter present a plane with automatic balance as well as a self-acting steering apparatus, and are so plentiful that they can be studied at any time. But the planes serve to explain the wing admirably, and after witnessing their performances with none, and either, and all of the contrivances for producing forward thrust, but little more need be said or done explanatory of their functions.

From the fore-leg of a reptile to this wing is doubtless a long

step. It must needs be. The reptile passes life in the midst of solid, non-elastic resistances; the bird lives a divided life, part of which is under the dominion of other laws. It copes with fluid elastic pressures when it navigates the air, and nature has transformed the creature to meet the changed conditions of its existence. One pair of legs is retained to treat with forces under the dominion of laws which operate in the reptile world in common with man's world, where the sea is level, and vertical forces point to the center of the earth; where motions are deliberate, impediments plenty, clashing activities found on all sides and the area of translation confined to two dimensions only. The other pair are changed to suit a very different world where the sea is a hillside, vertical lines variable, the plane of the horizon perpetually changing, impediments non-existing, velocities high and the third dimension added to the area of translation.

With the organ of flight understood, and the resolving power of planes working on air under the law of fluid pressure comprehended, there would seem to be no further impediment to the application of the axioms of mechanical science to the problem of air navigation.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Professor Woodrow has been finally condemned by the verdict of the highest tribunal of the denomination (Presbyterian) to which he belongs. This may cause considerable inconvenience to the professor, but we believe that it will do greater harm to the body which thus commits itself to a position which is antagonistic to the best light of to-day. It sows a seed which must produce unnecessary discord in a useful body of men, and which will interfere with its power for good, unless rescinded or disavowed. The fact of evolution is too well ascertained to permit such "bulls against the comet" to influence the thought of the day, but they make the way of truth more difficult than it ought to be.

The Rev. Dr. Deems it seems has been looking into the subject of evolution, and writes a book the conclusion of which is, that that doctrine is "not proven." Some things asserted by some evolutionists are certainly not proven, and some of these

assertions never will be; but these gentlemen have the severest of critics among their own craftsmen. Unless Dr. Deems has taken a thorough course in zoölogy and botany, and done a good deal of *species-work* on sufficient material, he is hardly in a position to offer an opinion.

And now the Rev. Noah Porter gives way to his prejudices, and thus expresses himself in his baccalaureate sermon before the Yale College graduating class:

"Those practical questions," he says, "which threaten to agitate and convulse society will very soon force every educated man to ask and to answer the comprehensive inquiry: Is there or is there not a kingdom of God slowly but surely lifting itself up in the sight of the nations, or is it a kingdom of science, a kingdom of fate and force, that has no promise for the poor, no comfort for the sorrowing, no justice for the wronged, no deliverance for the oppressed, or, at the utmost, nothing more than a blind tendency of progress toward the brilliant mirage that eternally flees before the disappointed vision?"

One is led to believe that President Porter is ignorant of the doctrine of evolution, that he should thus confound it with materialism and atheism. If "the kingdom of God" is a kingdom of morals, then the truths of evolution demonstrate the necessary near approach of such a kingdom, if not its complete establishment, through the necessary growth of respect for law engendered by social life. If the "kingdom of God" is a kingdom of love and good will, then evolution points to its infallible approach through the growth by exercise of the social affections. But supposing these agencies to fall short of the production of that state of perfection involved in the idea of the kingdom of God, this doctrine of science does not necessarily exclude the possibility of personal relations between man and a Supreme Being in the universe of mind. But such relations must have necessary orderly limits due to "the intractability of matter," just as human relations have such limits.

—— The present U. S. Geological Survey has adopted some methods which will make it less acceptable to the people of the country than were the organizations which preceded it. The present director has introduced the new rule that illustrations of scientific material will not be furnished unless such material is the

property of the Government. The objections to this rule are so numerous that we can only give a brief review of them:

(1) It restricts the survey to use of a range of material which is narrower than it should be. Much that is contained in private collections, especially in the department of palæontology, is unique, either entirely or partially, and must remain so always, or for a long time. The author then who wishes to present a truly scientific monograph to the survey is unable to do so; and the student must look through the usual variety of publications in order to get a complete report on any subject. This rule, therefore, destroys the chief merit of government publications, which consists in the fact that they can be, owing to the superior publishing capacity of the Government, more compendious than the publications of any private person or society.

Were this rule impartially applied, it would greatly curtail the value of the government publications, but as it is only used with reference to certain persons, its full effects are not yet apparent.

(2) The rule involves the survey in a great unnecessary expense of re-collecting material that already exists in the museums of the country. It involves loss of time in the necessity which results from the new study by persons unfamiliar with it. It involves loss of time in the delay which follows the repreparation of new material. It employs men at high salaries to do again work which has already been done. It thus causes waste where economy is highly important.

The opposite policy was pursued by the surveys which preceded the present one. The result naturally was a much greater amount of good work done for much less money. Naturalists worked for the survey for small salaries or even gratuitously.

The policy of selling the publications of the survey could not, as might have been expected, make any impression on this great expenditure. The demand for the annual reports has been, we understand, but small, and immeasurably below that which existed during previous administrations.

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RECENT LITERATURE.

THE OLDEN TIME SERIES.—Our thanks are due to Mr. Henry M. Brooks for gleaning the old newspapers of Boston and Salem in order to save precious tidbits of information otherwise in danger of moth and rust. Three of the series have appeared with the following titles: "Curiosities of the Old Lottery," "Days of the Spinning-wheel," "New England Sunday."

Much in each volume does not relate strictly to the title, and there is much that is merely quaint and curious, but the student of sociology will lose a great deal of precious information who does not carefully scrutinize these volumes.

With reference to lotteries, one reads with surprise of Faneuil Hall, Harvard College, the Commonwealth of Massachusetts, free schools, Episcopal and Congregational churches as beneficiaries of the golden wheel.

The Leicester Academy lottery is thus advertised: "As the design of this Lottery is for promoting Piety, Virtue, and such of the liberal Arts and Sciences as may qualify the Youth to become useful members of Society, the Managers wish for and expect the Aid of the Gentlemen Trustees of the Academy, the REVEREND CLERGY, and all persons who have a taste for encouraging said Seminary of Learning."

Volume II covers a wide area of subjects, but is equally rich in delightful mementos of last century. This is from the *Post Boy:* "To be given away, a Male Negro Child of good Breed, and in good Health. Inquire of Green and Russell."

Volume III, regarding New England Sunday laws, approaches a subject which the anthropologist just begins to study with his accurate apparatus and just methods. The laws of days are as universal in time and place as the human species. That men in large bodies acted in this way or in that is a fact, and their actions had an efficient and sufficient cause. To trace these to their sources and to study their effects on human weal are of the highest interest to us all. Here are a few laws from the statutes of Massachusetts:

"No one shall be a freeman, or give a vote, unless he be converted, and a member in full Communion of one of the churches allowed in this dominion.

"No one shall travel, cook victuals, make beds, sweep house, cut hair, or shave on the Sabbath day.

"No woman shall kiss her child on the Sabbath, or fasting day.

"No one shall read common prayer books, keep Christmas, or set days, make mince pies, dance, play cards, or play on any instrument of music, except the Drum, Trumpet, or Jewsharp.

"No one shall run on the Sabbath day, or walk in his garden, or elsewhere, except reverently to and from meeting."

The chief advantage of Mr. Brooks' method of treatment is that subjects are considered separately, and it is to be hoped that the author will continue his researches.

CONN'S MODERN EVOLUTION.[1]—This work is a timely presentation of the subject of evolution from the standpoint of the naturalist. The author touches but lightly the metaphysical aspect of the question. The contributive facts are taken up successively, and well presented. The various hypotheses are then stated, and their value discussed. This is the first work in which the Amer-

[1] *Evolution of To-day.* By H. W. CONN, professor of biology in the Wesleyan University, Middletown, Conn., 8vo, pp. 342. G. P. Putnam's Sons, 23d street, New York.

ican contributions to the subject are correctly represented, and in which they receive due attention. The author gives every contributor to the subject a fair showing, and avoids expressing his preferences in a positive manner. On the contrary, he does in some instances rather exaggerate the objections to the views which he endeavors ultimately to sustain. The honesty of purpose is unmistakable. We cite, for instance, his doubts as to the reality of the inheritance of acquired characters. A fuller acquaintance with vertebrate palæontology would have enabled Professor Conn to be more certain of this fact.

One of the merits of this work is its suggestiveness. It indicates to the reader the many lines of research which stretch in every direction from the comprehensive standpoint of the author. It cannot fail to stimulate research, especially in America.

The leaning of the author is towards the views of the Neo-lamarkian school, which have been especially developed in this country since 1867–8.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA AND THE ISLANDS.—*The Hill country of Assam.*—Mr. Needham's excursion in the Abor hills from Sadiya, on the Upper Assam, brought that officer into close communication with the savage Abors, whom he credits with being truthful and courageous. The village of Membo is on a site well chosen for defensive purposes. It is well supplied with pure water, yet two-thirds of the inhabitants have goitre. The houses are built on terraces hundreds of feet above each other. They are all massive buildings, sixty to eighty feet long by twenty wide, and have a large sheltered veranda in front. The boards of the fronts are often three or four feet wide, and the roof is thatched with the split stems of a thorny plant. There are no partitions inside, but privacy is not needed by a people whose women wear only a very short petticoat. Goitre was not noticed at other Abor villages.

Mr. Carles upon Korea.—The May issue of the Proc. Roy. Geol. Soc. contains Mr. W. R. Carles' account of his recent journeys in Korea. There are records to prove that Korea was inhabited in the twelfth century B. C., when Ki-tze introduced from China the first elements of civilization. It is evident, notwithstanding the seclusion in which the people have lived, that many stocks, including the Caucasian, entered into its original composition.

Korea contains about 90,000 square miles, and is divided into eight provinces. At the northern extremity lies Paik-to-san, the great mountain on which are the sources of the Amnok (Yalu) and Tuman, the rivers which form its northern boundary. From this mountain a range runs southwards, at no great distance from the eastern coast except at the extreme south, where it trends inland. The eastern coast has but few islands and harbors, and no rivers of any importance except in Kyong-Sang, at the south,

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

where the Naktong empties into the Broughton strait not far from the port of Fusan. The rise and fall of the tide along the eastern coast is very slight, at Gensan only two feet, while at Chemulpo, on the west coast, there is a rise and fall of thirty-eight feet. From Fusan westwards, and along the west coast, there are numberless islands and mud banks, interfering greatly with navigation. The Amnok is by far the grandest river, but the Tai-dong, Han (on which Soul is situated), Keum and Mok-pho are important.

The northern portions of Korea are mountainous and the scenery fine, but further south the mountains diminish until at length they are but low-lying hills.

There are in Soul few houses more than ten feet high, for even the dwellings of the better classes are low. The smallness of the houses seems to be compensated by the size and variety of the hats worn by the men. High conical hats, black or white, and of open texture, made of split bamboo, horse-hair, or wicker work, seem to be common, and some of these are topped with a little bee-hive covering of oil-paper to protect them from rain.

Drains are unknown in Soul, and the foul mass of decomposing matter lying on each side of the street is never cleaned save by a rain-storm. The houses are heated by a chamber below the winter rooms, at one side of which is the repository for the fuel, at the other a flue leading to the chimney, which is detached. At the ends of a house are the summer rooms, raised above the ground on corner-stones. The dwellings are built of wooden pillars supporting a heavy roof of wooden beams and tiles. The rafters are pared away so as to fit into sockets on the top of the pillars. The spaces between the posts are filled with masonry, the stones of which are often tied together with millet stalks, on account of the high price of lime. Eight feet by six feet, and five feet high, is a good room in a Korean cabin.

The road to Wi-ju, on the Amnok, is the high road of commerce north of Soul, as every track west of the mountains converges on it. Kai-sŏng, Phyong-yang and Wi-ju, on this route, are three of the most important cities in the country after Soul.

Hill towns, or cities of refuge, guarded by priest-soldiers, are found all over Korea; and message that the coast is clear is sent to the capital every evening from all parts of the provinces by means of beacons.

Kai-sŏng was the capital of the last dynasty, has about 30,000 people, and is the center of ginseng cultivation. Phyong-yang, upon the Tai-dong, is the most interesting town in Korea, and beautifully situated. Here are the grave and the portrait of Ki-tze.

Wi-ju (30,000) is the depot of all goods sent by the overland route to China. Communication between the two adjoining countries, even now that the strip of neutral ground once dividing

them has been incorporated with Manchuria, is limited to two points, Wi-ju on the west and Kyŏng-heung on the east. Gensan, at the entrance of Port Luzanef, on the east coast, has a neat Japanese town as well as a native one.

Bears, tigers, leopards, antelopes and several kinds of deer are plentiful in the mountains, but strangely enough wolves are not found south of the Amnok. Pigs, tiger-cats, badgers, foxes, beavers, otters and several martens are also found. Korea is rich in birds; many migratory kinds stop there on their passage; raptores are plentiful; swans, geese, mallards, mandarin ducks, teals, bustards, cranes, herons, egrets, curlew, snipe, etc., are abundant, and there are many woodpeckers.

Caste has great hold in Korea. No office of even local importance can be held except by nobles, and in the capital it is rare to find in office a man of even the second grade of nobility. Trade disqualifies nobles from the privileges of their rank, and some of these bear the most absolute poverty rather than enter into business. The middle class is small, consisting of doctors, painters, interpreters, scribes and the lower officials; all engaged in manual labor form the lower class, and below all others are butchers and tanners. Religion seems to be varied. The Confucian philosophy rules, but Buddhism and Taoism exist, and traces of some other faith appear in the *mirioks*, half-length figures carved in stone, with a cap different to that of Buddha.

New Guinea.—Mr. Forbes (March 10th) was in camp at Sugere, near Port Moresby, is on friendly terms with the natives, and intended to cross the Owen Stanley range when the rains ceased.

Captain Dickson reports that at Samoa haven, on the north coast, there are about fifty Germans, who appear to be healthy, and are on good terms with the natives, which is not the case at Finsch haven. Both these settlements are on small islands.

Captain John Strahan has re-ascended the Mai Kassa or Baxter river about 100 hundred miles, made several excursions to the interior, and discovered five smaller rivers between the Mai Kassa and the Gulf of Papua.

Asiatic News.—A. Konschin maintains that the Uzboi is not the old bed of the classic Oxus, but the result of the separation of the Aral from the Caspian sea, and of the overflow of the Aralo-sarykamish waters into the Caspian.

The Kermadec islands, which have recently been occupied by the English Government, are a group of rocky islets about 600 miles N. N. E. from the North island of New Zealand and due east of Norfolk island. The principal island is Raoul or Sunday island (29°, 12′ S. lat., 178°, 15′ W. long.) This is about twelve miles in circumference, rugged, and without an anchorage. It is covered with wood, and occupied only by a few white waifs and strays.

M. Merk has traveled in Seistan or Sistan, a district at the south-west angle of the Afghanistan. He reports that the Helmand rose to an unusual height last spring and flooded the Hanum through a trough leading to it from the Helmand. Forts, tombs, villages and pleasure-houses lie in ruins along this trough, and there are traces of the great Jui-karshasp canal. At Trakun was a fort in perfect preservation as though just abandoned. According to tradition the inhabitants left it about three generations ago.

AFRICA.—*Madagascar.*—An interesting account of the geography of Madagascar, which is claimed frankly as "une terre Française," is given by M. Georges Richard in the *Revue Scientifique* of April 3d. The little explored central mountain mass contains several plateaux, while between the spurs which diverge seaward, and often form a series of platforms, are fertile valleys, watered by streams, few of which are navigable. The most considerable of these are on the west side, and are the Onilahy, the Mangoko, the Sigiboujy and the Ikiope and Betsiboke, which unite and debouch in the bay of Bombetok. The mouths of the rivers upon the eastern coast are almost always obstructed by moving sands, and those of the smaller rivers are completely choked with the branches, tree trunks, etc., brought down in the wet season, so that they form extensive marshes—the source of the Madagascar fever. The climate of the interior is healthy.

Algeria.—The *Revue Scientifique* has recently published a series of articles upon the geography of Algeria, from the pen of M. A. LeChatelier. From these we learn that the southern frontier of the French possessions is fixed in the west and east by the Erg, a region of inextricably confused sand dunes of every form, passable only by certain lines. The ouedje, or region immediately north of the Erg, consists of a succession of ridges diminishing in height northward. Between these undulations are sandy bottoms or pebbly plains, with pasturage and water. The Erg in the eastern part of the boundary of Algeria is furrowed by depressions called *Gassi*, scooped out by the winds, but none of these, except that of Mokhauza or Ir'har'har, traverse the entire width of the Erg. The tribes under French rule do not in the east of Algeria advance beyond the northern borders of this sandy desert, while the tribes of the southern Sahara do not reach to its southern border. The western part of the southern border of Algiers is also formed by the Erg as far as the territories occupied by tribes which recognize the suzerainty of the Sultan of Morocco, but here the southern independent tribes advance to its crest, and the barrier is less complete. Between the eastern and western Erg are vast plains traversed by the oued Mya.

The oasis of Tuat has not been annexed by France, and M. Chatelier advocates its independence under French patronage,

The Sultan of Morocco exercises much influence, but there is really complete anarchy in this territory of about 400,000 souls. The power of this sultan in all the Mussulman countries west and south of Algeria is, by M. Chatelier, compared to that of the popes in Europe during the middle ages, but has been strengthened by the conquest of Algeria by the Christians.

African News.—Dr. Fischer, whose relief expedition was at the southern end of Victoria Nyanza in January last, states that Mr. Mackay, the English missionary in Uganda, had received a letter from Emir Bey, informing him that he and Dr. Junker, with Captain Cassati, were safe in Unyoro with King Kabarega. Negotiations with the King of Uganda for leave to cross Victoria Nyanza from Kagehi to Rubaya have fallen through, so it is not known what steps Dr. Fischer will take to reach the travelers. Dr. Oscar Lenz is endeavoring to reach the missing travelers by way of the Congo, has had several interviews with the great Zanzibar trader Tippo Tib, and is trying to recruit porters among the Swahili. His intention is to push forward to Lake Muta Nzige, and thence to the old Egyptian stations on the White Nile.——The French staff officers are busy continuing the Paris meridian to Laghouat, about 4° south of Algiers. When this work is finished the line will be measured with precision from the Orkneys to this locality.——Baron Schwerin, the Swedish explorer on the Congo, landed at the mouth of the Chiloango, whence he proceeded on foot to Banana by Cabinda and Cacongo, making many valuable observations on the shore lines and terraces of the gradually rising coast, and of the effects of the tide on the sandy fore shore. He also paid great attention to the influence of ocean currents upon the direction of the flow of rivers in their lowest course.——Mr. Last has traveled up the right bank of the Lujenda to its source. It is fertile and thickly peopled throughout. The natives all assert that the waters of Lake Kilwa rise every rainy season, and then drain or filter through the sandy mound which separates it from the Lujenda.

AMERICA.—*The Gran Chaco.*—Colonel Juan F. Cretz has summarized the work done in the Gran Chaco by the expedition sent by the Argentine Government at the end of 1884. The mean height of the Chaco above sea level is 984 feet, the Central Chaco being in general 100 to 130 feet higher than the southern. The district is one of modern alluvial formation; no rocks were found anywhere. Extensive primeval forests, with open grassy spaces between, are found in the interior of the Southern Chaco. Water is obtainable at or near the surface, except in the district between 27° 21′ and 29° 05′ S. lat., and 62° 04′ and 62° 57′ W. long., when the soil is sandy and impregnated with saltpeter.

The Bermejo has been explored throughout its whole length,

while the recent expedition explored the Pilcomayo for 350 miles upwards. The Rio Salado, between the Bermejo and the Pilcomayo, seems to come from the vast marshes formed by the latter between 22° 30′ and 23° 30′ S. lat. The water of the Salado is not drinkable, its banks are marshy, its breadth varies from 125 to 130 feet, and its depth averages six. On both sides are extensive forests and fine pastures. The expedition explored 20,000 square miles. The Central Chaco has an area of 41,780 square miles, and the Southern Chaco contains 60,000 square miles. There is a great variety of useful woods. The climate is reported to be healthy, the chucho or ague of Tacuman, Jujuy and other tropical regions being unknown.

Ocean.—The *Enterprise*, Commander A. S. Barker, has run a line of deep-sea soundings from Wellington, N. Z., to the Straits of Magellan. At 118 W. long. the depth was but 1562 fathoms, the depth increasing east and west of this. This rise probably indicates a ridge from Easter island (27° 09′ S. lat., 109° 25′ W. long.) and Dougherty or Keates island (59° 21′ S. lat., and 119° 07′ W. long.). This line of soundings runs very close to the ice-limit. The *Challenger* in 1875 ran a line in about 40° S. lat., and in the same year the German ship *Gazelle* executed a series of soundings between that of the *Challenger* and that of the *Enterprise*.

The U. S. Hydrographic Office has laid out a plan by which the entire Pacific, north of the *Challenger's* line, can be surveyed by lines run at short distances apart. This will be carried out from time to time by U. S. war vessels.

GEOLOGY AND PALÆONTOLOGY.

Schlosser on the Phylogeny of the Ungulate Mammalia.[1]—We have in this memoir a comprehensive review of a subject which has received large accessions during the last decade. The discoveries made in North America and in France have given the opportunity for a summary of results, so that Dr. Schlosser's memoir is timely. The paper will prove of the greatest service to students of the subject who, for whatever reason, have not had access to all of the literature. The grasp of the subject displayed by the author is comprehensive, and his knowledge of details thorough. His immediate source of materials is the museum of the University of Munich, under the direction of the distinguished geologist and palæontologist, Professor Zittel. Besides 136 pages of text there are six well-executed lithographic plates. An appendix contains descriptions of four new genera and three new species of Artiodactyla.

[1] Beiträge zur Kenntniss der Stammesgeschichte der Hufthiere und Versuch einer Systematik der Paar- und Unpaarhufer. Von Max Schlosser. Morphologisches Jahrbuch, Leipsic, 1886.

To the American palæontologist the greatest value of this memoir consists in its descriptions and inferences as to the history of the Artiodactyla. The materials for this study are more limited in America than in Europe.

Dr. Schlosser gives full credit to work done and conclusions reached in America. He adopts the views here proposed as to the ancestral position of the Condylarthra; and also the theory of the phylogenies of the teeth and feet of Mammalia proposed by Cope. The only defect in knowledge of American literature we observe, is the case of the report on the vertebrate palæontology of Colorado, published in the Annual Report of the U. S. Geol. Survey of the Terrs. for 1873. On this account the characters of some genera are overlooked.

There are some positions adopted by the author which we suspect that he will modify. Thus his systematic views are different from those which have been usually held, in that he uses phylogenetic series as identical with taxonomic divisions, and not, so to speak, as transverse to them. The effect of this method is to make his families not only heterogeneous, but to leave them without exact definition. This is readily seen in the case of his "family Hyracotheriidæ or Equidæ," which includes these two genera and all the forms between them. The definitions of this family which are given (p. 33) are not true of Hyracotherium. Although there can be no doubt that this genus is the ancestor of Equus, all taxonomic precision requires that it should be placed in a distinct family from that genus, and in company with genera (*e. g.*, Systemodon) which Dr. Schlosser places (p. 27) in his Tapiridæ. To illustrate this matter more precisely I give the phylogeny of Equus arranged in the family phases through which it has, in my opinion, passed, and as I have given it:

Equus	belonging to	Equidæ
Protohippus, etc. / Anchitherium	"	Palæotheriidæ
Lambdotherium	"	Chalicotheriidæ
Hyracotherium	"	Lophiodontidæ

I might carry this kind of illustration through nearly all of Dr. Schlosser's taxonomy, but this example will suffice.

A principal cause of this and other diversities between the views of the author and the present reviewer, in matters of detail, is the opinion maintained by the former (p. 5) that the dentition is as important in tracing phylogenetic lines as are the feet. Of course there is no doubt as to the importance of the dentition. Nevertheless the author admits that in Ungulates the feet form the primary basis of classification, by his adoption of the

divisions based on their structure, *e. g.*, Condylarthra, Amblypoda, "Paar- und Unpaarhufer." Within each of the latter he admits bunodont and lophodont forms. It is in the Condylarthra that he hesitated to admit the lophodont form Meniscotherium, and is disposed to place it in the Perissodactyla on account of its dentition; a proceeding in which we cannot agree with him. It is considerations derived from the dentition that lead Dr. Schlosser to believe that the Diplarthra have descended directly from the Condylarthra, without intervention of the Amblypoda as I have maintained. I have stated my reasons for adhering to the latter position in the last number of the NATURALIST (1886, p. 615; The Phylogeny of the Camelidæ).

In tracing phylogenies the difficulty consists in the relative valuation of characters. It is very easy, for instance, to give characters, which are only of specific value, more importance than belongs to them. The length of the bones of the feet and legs it is true have increased with geologic time in general, but it is very probable that in some groups there has been a retrogression in this respect, especially where great bulk has been attained. The line of the Amblypoda has probably had such a history, since its earliest genus, Pantolambda, is the most slender. Such has probably been the history of the Hippopotamidæ and (as to the feet) Elephantidæ. Such is admitted to have been the case with the Bovidæ, in which Dr. Schlosser regards the robust form Bos as the descendant of the slender Gelocus. Such has probably been the history of Rhinocerus, which Dr. Schlosser objects to deriving from Hyrachyus on account of the more slender feet of the latter.

There is an important discussion as to the origin of the milk dentition (p. 109). Dr. Schlosser refers to Baume's hypothesis that the temporary dentition consists of those teeth which have been thrown out of the regular series by the contraction of the regular series. A preferable hypothesis is that of Wortman, which regards the mammalian dentition as following a law of succession fundamentally that of the reptilian, the reduction consisting in nothing but anteroposterior members.[1]

I add that Elasmotherium is much more probably derived from Cœlodonta than from Aphelops. Also that the American Elotherium has but two metapodial bones, like the European. Also that the reviewer's illustrated articles in the AMERICAN NATURALIST are mostly of later date than the Vol. III Report U. S. Geol. Survey Terrs.—*E. D. Cope.*

GEOLOGICAL NEWS.—*General.*—M. E. Jourdy has found spirifers in the marble of the delta of Tonkin (Tonquin, Tong-king) and therefore concludes that this marble, which occurs both in Tonkin and Annam, is of Carboniferous age. At Dong-Song he

[1] System of Dentistry, Philadelphia, 1886.

has collected fossils which are of triassic age; while the plants of the coal-basin of Hone-Gay have been referred to the Rhætian period. According to these observations the Trias is, in the interior, superposed upon the Carboniferous, while the coast coal-measures of infra-Liassic age rest directly upon the carboniferous limestone in one of its folds. The actual coal-beds do not appear to extend beyond Dong-Trieu, but the strata are more extensive, and it is not unlikely that detached portions of coal may be found among the hills of arkoses which rise out of the rice-fields of the Delta. The beds of coal are thick upon the level of the soil, very little above the sea, and near to it, but the quality of the combustible is inferior.

Cretaceous.—Paul Pelseneer (Bull. du Mus. Roy. d' Hist. Nat. de Belgique) describes certain remains of a macrurous crustacean found in the green sand of Grandpré, in the Ardennes. From the sum of its characters it is clearly an Astacomorph, and the form of its rostrum (without lateral spines) places it in the genus Hoplopariæ. The new species is named *H. benedeni.* Comparison of Hoploparia with Homarus and Nephrops induces M. Pelseneer to consider it nearly related to the former genus.

Pliocene.—Sir R. Owen has recently described two species of saurians, allied to Megalania, from remains found on Lord Howe's island. Smaller than *Megalania prisca,* and with some differential characters, they form the genus Meiolania. Both species are toothless, with modifications of the jaws suggestive of a horny beak, but the cranial and vertebral characters are sauroid. Three pairs of horn-cones are present, with feeble traces of a seventh more advanced medial horn. The tail is long and stiff, its vertebræ encased in an osseous sheath developing tuberous processes corresponding with the vertebræ. Lord Howe's island is an insular tract six miles by one mile, situated midway between Sydney and Norfolk island. It consists of three raised basaltic masses connected by low-lying grounds of blown coral-sand.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In the June number of the *Geological Magazine* Professor Judd has an interesting article[2] in which he treats of the structure and origin of the little glassy balls known as Marekanite, from their occurrence—the great Marekanka, near Okhotsch, in Siberia. A résumé is given of the work previously done on the subject and some additional observations are recorded. According to Judd the internal structure of marekanite balls differs from that of Prince Rupert's drops in that they contain volatile ingredients in such quantity that when heated the entire mass

[1] Edited by W. S. BAYLEY, Johns Hopkins University, Baltimore Md.

[2] On Marekanite and its Allies, p. 241.

swells up until it has attained eight or ten times its original bulk, when it assumes all the characteristics of a true pumice. Thin sections show under the microscope a flow structure. Devitrificative products are abundant, while porphyritic crystals are of small sizes, consisting almost entirely of hornblende, magnetite and a brown mica. From a consideration of all the facts and a comparison of similar occurrences of rocks in other localities, the author concludes that the tension which affects large rock masses manifests itself in the structure of the nuclei of perlitic masses. He further observes that the parting which produces columnar structure in rocks owes its origin to the contraction which takes place during cooling. The secondary system of curved cracks which gives rise to perlitic and similar structures are more probably due to the contraction which goes on as the volatile materials which they contain are slowly separated from them.——A very important contribution to the subject by regional metamorphism has recently been made by C. R. Van Hise,[1] who is working with Professor Irving on the Archæan rock of the Northwestern States. In this article the author gives in a very condensed form the result of his studies on the rocks of the Penokee-Geogebic iron-bearing series in Wisconsin and Michigan, and promises that a full treatment of the subject will appear later in a memoir by Professor Irving and himself. This formation extends in a general east and west direction for a distance of eighty miles through parts of Wisconsin and Michigan. It is younger than Keweenawan and in its upper members differs in different localities. The group consists principally of mica schists, black mica slates, graywackes and quartzites. In the eastern portion of the belt the predominent rocks are feldsparic quartzites, passing to the west into chloritic and biotitic graywackes, and finally into mica schists and black mica slates. According to the author "these rocks, at present of such widely varying character, microscopic study shows to have been originally in essentially the same condition. All were once, as some are still, completely fragmental rocks composed chiefly of quartz and feldspar, mingled in places with a little clayey matter, perhaps also with a small quantity of fragmental mica and some feerite. * * * The quantity of feldspar was apparently considerably greater in rocks of the western part of the area than in those of the eastern part." The quartzites, graywacke and graywackment slates are all indurated,[2] *i. e.*, the quartzes, and in some cases the feldspar fragments, have been enlarged by the deposition around them of interstitial quartz material, and accompanying this there has been an alteration of the feldspar into chlorite. The processes by which the mica schists and black slates have reached their present condition are much the same as the above,

[1] Upon the origin of the Mica Schists and Black Mica Slates of the Penokee-Geogebic Iron-Bearing Series. *Amer. Jour. Sci.*, XXXI, June, 1886, p. 453.

[2] Cf. Bulletin U. S. Geol. Survey, No. 8.

except that the feldspar, instead of changing into chlorite, has altered to muscovite and biotite, "the result being the production from a completely fragmental rock, by metasomatic changes only, of a rock which presents every appearance of complete original crystallization, and which would be ordinarily classed as a genuine crystalline schist." In order to show that there exists a regular gradation between the quartzites and mica schists, Van Hise describes the microscopical characteristics of fine slides, beginning with a muscovitic and biotitic graywacke, with enlarged quartz grains of clastic origin, to a muscovite biotite schist, which is apparently a typical mica-schist. A study of sixty slides shows that this regular gradation can be clearly traced from undoubted clastic rocks through graywackes to mica schists, which can not readily be distinguished from the ordinary schists to which a different origin can be attributed.——The metamorphic rocks of California have been studied by G. F. Becker,[1] and some remarkable results have been reached. Like the article of Van Hise's referred to above, this is also an abstract of a monograph of the U. S. Geological Survey. It gives the results of the study of thin sections of Californian rocks, and leaves the details to the monograph for elaboration. The rocks studied cover a belt of the coast ranges, 230 miles in length. The sedimentary rocks of the series are underlain by granite, from which they have been derived. Their most interesting alteration "consists chiefly in the metasomatic recrystallization of the sediments to holo-crystalline feldsparic rocks carrying ferro-magnesian silicates and in the formation of vast quantities of serpentine. It is also clear on structural and chemical grounds that solutions rising from the underlying shattered granite co-operated in the metamorphism." The microscope shows that the main constituents of the sandstones are quartz, biotite and hornblende, with the usual accessory minerals. The metamorphic rocks derived from these pass over into one another by degrees. For convenience the author divides these into *partially metamorphosed sandstones*, in which recrystallization has begun; *granular metamorphics*, consisting of a holocrystalline aggregate of augite, amphibole, feldspar, zoisite, quartz and accessory minerals; *glaucophane schists*, derived from certain shales much as the granular metamorphics are derived from the sandstones; the *phthanites*, calcareous schistose which have been subjected to a process of silicification resulting in chert-like masses; and finally the *serpentines*, which have resulted in part from the direct action of solutions on sandstones and in part from alteration of the granular metamorphics. The more important stages in the process of recrystallization can be traced under the microscope. One of the first stages is the resolution of the clastic grains into crystalline aggregates from which new minerals are

[1] Cretaceous Metamorphic Rocks of California. *Amer. Jour. Sci.*, XXXI, May, 1886, p. 348.

again built up. Several very remarkable instances of this are described. A further development of these processes yields rocks in which the fragmental character of their constituents can not be detected. These form the group of the granular metamorphics, which are subdivded into *amphibolites*, *metamorphic diorites* and *metamorphic diabases*, in which the pyroxene is sometimes diallage. Glaucophane and zoisite occur in most of the rocks of this class. The most interesting portion of the paper is that which treats of the origin of the serpentine. Field observations show that the mass of this rock is derived from the sandstones. Under the microscope it can be shown that all of the principal components of the sandstones and granular metamorphic rocks are subject to serpentinization. Grains of hornblende, augite, feldspar, apatite and *quartz* can be seen undergoing an alteration into serpentine. To account for the peculiar features of this widespread metamorphism the author supposes that at the time of the disturbances the water which the sandstones and granite contained was forced out in a heated condition. It was at first basic, and in its course converted some of the sandstones and shales into holo-crystalline augite and amphibole rocks. Serpentinization then followed at a lower temperature and finally silicification ensued, the solutions having now become acid.

MINERALOGICAL NEWS. — Argyrodite, the mineral in which Winkler has discovered the new element germanium,[1] has been described by Weisbach,[2] of Freiberg. It is found at the Himmelsfürst mine, near Freiberg, where it occurs in groups of little rounded crystals about one millimeter in length. They have a metallic luster; are steel-gray on crystal planes and reddish on fresh fracture surfaces; have a hardness of 2½ and a specific gravity 6.085–6.111; are brittle and have no cleavage. The crystal system is monoclinic, the principal planes being ∞P, $P\infty$, $-P\frac{2}{3}$, $6P\overline{\infty}$, $\frac{1}{3}P\overline{\infty}$ and occasionally $P\overline{\infty}$ and $6P\frac{2}{3}$. $a : b : c = 1 : 1.67 : 0.92$. $\beta = 70°$. Elbow-shaped twins and drillings are occasionally met with in which the twinning plane is at right angles to $6P\overline{\infty}$ and parallel to the combination edge $\infty P : P\infty$. According to Winkler[1] argyrodite contains 73–75 per cent of silver. The percentages of sulphur and germanium have not yet been accurately determined.——A new variety of kobellite is mentioned by H. F. and H. A. Keller[3] from the mines of the Lillian Mining Co., Leadville, Col. The unaltered mineral is of a steel-gray color. It is fine grained, crystalline, with a metallic luster, and gives a black streak. An analysis of pure material yielded:

S	Pb	Bi	Ag	Cu	undissolved residue
15.23	44.08	33.27	5.66	trace	0.15

[1] Berichte der Deutschen Chemischen Gesellschaft, XIX, No. 3, p. 210.
[2] Neues Jahrb. f. Mineralogie, etc., 1886, II, p. 67.
[3] Ib., p. 79.

The formula corresponding to this composition is 3 (Pb, Ag_9) S Bi_2 S_3, which differs from that of kobellite [3 Pb S $(Bi\ Sb)_2$ S_3] in the absence of antimony.——W. Cross has recently[1] added topaz and garnet to the list of well-crystallized minerals found in the lithophyses of the rhyolite of Colorado. The occurrence of these two minerals had been referred to before by Mr. J. A. Smith,[2] but it has been left for Mr. Cross to give us a definite description of them and their paragenesis. The outer walls of the lithophyses as well as their concentric shells are primarily formed of sanidine in small stout crystals, of which the transparent ones possess a beautiful blue color[3] in the direction of the plane $\frac{1}{2}^5$ P $\overline{\infty}$. In isolated crystals in these lithophyses clear, transparent, dark-red garnets occur. They have an average diameter of 2.5$^{cm.}$ The planes $2O_2$ usually show a striation parallel to the dodecahedral edge. An analysis of selected material from parts of thirty crystals yielded Mr. L. G. Eakins:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	K_2O	Na_2O	H_2O
35.66	18.55	0.32	14.25	29.48	1.15	0.27	0.21	0.44

The mineral is a typical spessartite, an aluminous garnet in which the calcium has been replaced by manganese and ferrous iron. Topaz appears much less abundantly than garnet. Its crystals are prismatic, clear and transparent, either colorless, pale-bluish or distinctly wine-yellow. The usual forms are ∞ P, 2 P, ∞ P$\breve{2}$, O P, 2 P $\breve{\infty}$, 4 P $\breve{\infty}$, ∞ P $\breve{\infty}$, ∞ P $\breve{3}$, and 2 P $\overline{\infty}$. The largest crystals measure half an inch in the direction of the brachy-axis; the average diameter is about one-eighth of an inch. On closely comparing crystals obtained from open cavities with those found in the body of the rock, the former were seen to be colorless or of a pale-bluish tint, while the latter were most frequently wine-yellow. This difference is thought to be due to bleaching by sunlight, an effect which was noticed by Kokscharow[4] in the case of a wine-yellow topaz from the Urals. The paper closes with the results of the analyses of the only three rhyolites known to contain topaz in the manner described.——An analysis of a limonite pseudomorph after pyrite yielded Dr. E. G. Smith:[5]

SiO_2	S	FeO	Fe_2O_3	CaO	MgO	loss in ignition
6.25	0.31	0.91	80.21	0.04	0.40	11.72

——Mr. S. L. Penfield describes[6] brookite from Magnet cove, Arkansas, with a habit differing slightly from that usually seen on this mineral. The observed forms are P $\breve{2}$, $\frac{1}{2}$ P, $\frac{1}{2}$ P $\breve{2}$, ∞ P $\overline{\infty}$, ∞ P and 2 P $\breve{\infty}$, with $\frac{1}{2}$ P predominating.

[1] American Journal of Science, XXXI, June, 1886, p. 432.
[2] Report on the Development of the * * * Resources of Colorado, 1881–2, p. 36.
[3] Bulletin U. S. Geol. Survey, No. 20, p. 75.
[4] Bull. Acad. St. Petersbourg, 4, 569, 1861.
[5] Amer. Jour. of Science, XXXI, May, 1886, p. 376.
[6] Ib., p. 387.

MISCELLANEOUS.—R. Brauns proposes[1] the use of methylene iodide as a means of separating the constituents of rocks. The specific gravity of the liquid is 3.33 at the ordinary temperature, varying from 3.3485 at 5° to 3.3045 at 25°. The author claims for this substance advantages over the heavy solutions now in such general use, while he recognizes at the same time the disadvantages of the necessity for the use of benzine in diluting (neither alcohol nor water can be used for this purpose). The physical properties of the substance are given in detail, and an experiment made to test its practicability as a medium for the separation of minerals of high specific gravity shows it to work very satisfactorily.

BOTANY.[2]

AIDS TO BOTANIZING.—The young collector prizes everything which will help him in his search for specimens and his efforts to prepare and preserve them in his herbarium. The last number (June) of the *Botanical Gazette* ought to satisfy every demand of the inquirer after the best botanizing methods. The general methods of making specimens are treated in notes and communications from ten different botanists. How to collect certain plants receives the attention of twenty-one specialists. The Gray Herbarium and the National Herbarium are described with some fullness, and the remaining pages are filled with numerous short notes, all bearing upon the general topic of the number. It is impossible to summarize the information brought together in this valuable series of communications. Perhaps the one fact most prominently brought out, is that good specimens are made by *care and painstaking*, rather than by following this or that particular method. The lesson of greatest importance to the beginner taught in this herbarium number, is that he must make *good specimens*. It is not enough to gather samples and dry them; the work must be well done—artistically done, one might almost say.

Another lesson which the young botanist will learn, is that botanizing, to-day, is somewhat enlarged above what the fathers knew and practiced it. Flowering plants, ferns, mosses, liverworts, lichens, fungi—big and little, seaweeds—from the sea itself and from the fresh water—all these are to be looked for, gathered, prepared, mounted, arranged.

The Botanical Collectors' Hand-book, published a few years ago by Professor W. W. Bailey, will also be found to contain much of value to the young collector. Many of the suggestions it contains will materially shorten the work of the beginner.

In the Bulletin of the Torrey Botanical Club, the subject of herborizing was well treated by Lyman Hoysradt eight years

[1] Neues Jahrb. f. Mineralogie, etc., 1886, II, p. 72.
[2] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

ago, and the beginner will do well to read carefully the directions there given.

Much of what was included in Mr. Hoysradt's articles is to be found, along with a good deal of additional matter, in Section IV, of the tenth chapter of the new edition of Gray's Botanical Textbook, Vol. I. For flowering plants, the treatment here is probably the most satisfactory to be found anywhere, and no one can afford to omit its careful perusal.

A BROADER ELEMENTARY BOTANY.—In the schools and colleges of this country the teaching of elementary botany is still but little improved, however much of change for the better the higher departments may show. In fitting up our laboratories, providing means for studying cells and tissues, gathering collections of all sorts of materials and specimens, from German herbarium specimens of bacteria to trunks of great trees, we have done well for the classes of somewhat advanced students, but have we not in our zeal for improvement in these lines forgotten or ignored elementary botany. The beginner finds that with all this talk of improved methods he is still obliged to pursue the same old tread-mill course with its endless list of bare technicalities and meaningless botanical jargon. Beyond his field of elementary work he sees evidence of great activity among teachers, but *his* work remains almost precisely what it was a score of years ago, in spite of the fact that in this period the great science of plants has undergone a complete transformation.

What should an elementary course in botany include? The answer to this question will vary somewhat according to the particular penchant of the teacher, but certainly all who teach to a purpose will agree with the following propositions: 1. Elementary botany must be, to a certain extent, complete in itself, inasmuch as the greater number of students pursue the subject no further. 2. It must be properly a fitting introduction to the higher work.

The experience of the writer has brought him to the following conclusions, viz: 1. That both of the foregoing objects require a general view of the vegetable kingdom. 2. That both likewise demand that this general view be secured by the method of taking particular species and using them to illustrate groups. 3. That the student should "collect" specimens in every department of the vegetable kingdom, not so much for the sake of making specimens, as for the purpose of becoming acquainted with their general appearance, structure and habits. 4. That the student should become familiar with the methods of describing and identifying natural objects by a closer study of a few species of some group. In practice the flowering plants may well serve for the latter, although there is no good reason why a student might not take any other group whose individuals are abundant,

and the species of which have been well described.—*Charles E. Bessey.*

WATSON'S CONTRIBUTIONS TO AMERICAN BOTANY, XIII.—This contribution, published June 2, in the Proceedings of the American Academy of Arts and Sciences, Vol. XXI, includes the following, viz: I. List of plants collected by Dr. Edward Palmer in Southwestern Chihuahua, Mexico, in 1885. II. Descriptions of new species of plants, chiefly from the Pacific States and Chihuahua. III. Notes upon plants collected in the Department of Yzabal, Guatemala, February to April, 1885—1. Ranunculaceæ to Connaraceæ. IV. Notes upon some palms of Guatemala. Many new species are described in these four papers, and in the third and fourth we have an introduction to a little-known botanical field. The notes upon the palms of Guatemala are particularly interesting.

BOTANY AT THE APPROACHING MEETING OF THE A. A. A. S.—The conditions are all favorable to an excellent meeting at Buffalo in August, and a large attendance of botanists is confidently expected. It is hoped that there will be more botanists present than at any previous meeting. Let it be remembered that there are two organizations before which botanical papers may be read, viz: The Biological section (F) of the Association, and the Botanical Club. Before the latter all the shorter and less important matters should be brought, such as local lists, notes, notelets, laboratory suggestions, etc., etc. Let only *the best* papers be entered for reading before Section F. Let the effort be continued to rescue botany from the discredit into which it had fallen. Let the charge of superficiality in papers and discussions be made no longer true.

BOTANICAL NEWS.—Millspaugh's American Medicinal Plants, published by Bœrick & Tafel, of Philadelphia, has reached its fourth fascicle, carrying the number of plants thus far figured and described up to one hundred and twenty. The work is very well done, and merits the success which it has evidently attained.——A paper of a good deal of value to algologists was published recently by Dr. Farlow, under the title of Notes on Arctic Algæ. It is based principally on collections made at Ungava bay by Mr. L. M. Turner.——It is gratifying to note that in the Proceedings of the American Forestry Congress, held in Boston, September, 1885, some of the papers published appear to have a permanent value. It encourages one to hope that the days of fine talk alone among professional foresters in this country have passed away, and that henceforth we may look for work and papers which have scientific value.——Professor L. H. Bailey, in a lecture entitled "The Garden Fence," read at the meeting of the Massachusetts State Board of Agriculture, December, 1885, makes a

strong plea for a botany broad enough to take in the plant under cultivation, and for a horticulture scientific enough to demand and use the laws and facts of scientific botany.——The Flora of the Yellowstone National Park, by Frank Tweedy, is a neat pamphlet of seventy-eight pages, enumerating 657 species of Phanerogams and Pteridophytes found growing in the park. The main list is preceded by special lists of the forest trees, alpine flora, bog flora, flora of the hot springs and geysers, the grasses, etc.——A new edition of the London Catalogue of British Plants is noticed by the English botanical journals. It is edited by Frederick J. Hanbury, and is published by Bell & Son, of London.——The editor of *Grevillea* (146 Junction road, London, N., England) offers for sale a number of botanical books of some rarity, together with others not so rare, but quite as desirable; also, several valuable exsiccati.——Douglas H. Campbell published in the June Bulletin of the Torrey Botanical Club a neatly-made-out list of the plants of the Detroit river. It is surprisingly large. ——The *Journal of Mycology* for June continues the synopsis of the North American Hypocreaceæ, by Messrs. Ellis and Everhart.——The editor of this department would again ask collectors to remember his request for specimens of Cuscutæ in flower and fruit. Dense flowering forms of each species are particularly desired.

ENTOMOLOGY.

Hubbard's Insects Affecting the Orange.[1]—This elaborate report does great credit, not only to the author but to the U. S. Entomologist, who has projected the series of special reports of which this forms the most important. Mr. Hubbard's work was confined to Florida, and his report is thoroughly practical and forms a hand-book adapted for those whose knowledge of entomology is but slight.

A host of insects prey upon the orange, and of those directly injurious the list is a long one. In the winter little injury is experienced, but in February most of those kinds injurious to the orange make their appearance, and in May and June attain their greatest activity.

To the entomologist the portions of this report most interesting is the account of the rust mite, *Typhlodromus oleivorus* Ashm., of *Papilio cresphontes*, *Lagoa opercularis*, the account of the different species of bag-worms, or Œcetici; the different beetles boring in the wood and bark; the parts concerning the two species of Psocus, whose habits are described; also the notices and illustrations of other species, both destructive and beneficial.

[1] U. S. Department of Agriculture. Division of Entomology. Insects affecting the orange. Report on the insects affecting the culture of the orange and other plants of the citrus family, with practical suggestions for their control or extermination, made, under direction of the entomologist, by H. G. Hubbard, with fourteen plates and numerous wood cuts. Washington, 1885. 8 vo, pp. 218.

The illustrations are for the most part very good, while the chromo-lithographs, from sketches by Mr. F. D. Owen, are most excellent. The report will be most serviceable to orange-growers, and also contains many new observations of special interest to entomologists.

Stridulating and Sense-organs in Diplopod Myriopoda.—Mr. G. C. Bourne describes several points in the anatomy of Sphærotherium, which have been overlooked by previous writers. The genus differs from Glomeris in the position of the antennæ in a deep fossa. Corresponding to each of the twenty-one pairs of legs is a pair of "tracheal plates" placed between the attachments of the appendages. The first three pairs belong to as many segments, while of the remainder, like the legs, two pairs belong to each segment; there is also a nerve-ganglion to each segment. In the male there are three extra pairs of appendages, copulatory in function; two pairs of these bear stridulating organs which have not been previously noticed in this genus; besides the chitinous ridges on these appendages, there are similar ridges on the inner surface of the large terminal tergite.

The tracheal system differs from that of most other Diplopods in having very well developed branching tracheæ. Each tracheal plate carries a stigma, which opens into a "tracheal sac." From this sac two main tracheal trunks pass out, each of which breaks up into a number of smaller branches. The author considers the tracheal sacs homologous with those of Peripatus, from which form these branching tracheæ are derived.

The antennary sense-organs are conspicuous. An error is pointed out in the description of their histology by Bütschli, who mistook certain cells, in the connective tissue surrounding the nerve bundles, for ganglion-cells. An auditory organ is presupposed by the existence of a stridulating organ. The cavity opening to the exterior by a small pore below the eyes is regarded as such an organ; it is lined by a sensory epithelium, supplied by the nerve-fibers from the cerebral ganglion.—*Journ. Roy. Micr. Soc., April, 1886.*

Entomological News.—It was reported at a conference organized by the Zemstvos of nearly all the southern provinces of Russia, that almost all the southern districts suffer greatly from the Hessian fly.——At a meeting of the Linnean Society of New South Wales, held March 31, Mr. A. S. Olliff described a new aphanipterous insect from New South Wales, under the name of *Echidnophaga ambulans.* It was found in large numbers on the head and breast of a porcupine ant-eater *Echidna hystrix.* It differs from the *Pulex echidnæ* of Denny, from the same host, in habit as well as in several important points of structure, and is therefore referred to a new genus. Unlike other fleas, this species does not appear to possess the power of leaping.——Mr.

O. W. Oestlund publishes, in the Fourteenth Annual Report of the Geological and Natural History Survey of Minnesota, a list of the Aphididæ of that State, with descriptions of a number of new species.——The Entomological Society of Washington have issued, in a pamphlet of thirty-two pages, the first number of its Proceedings, which contains some interesting notes.

ZOOLOGY.

Geographical Distribution of Pelagic Marine Animals.—Herr C. Chur (*Zool. Anzeiger*, p. 35) ascribes the wide distribution of pelagic forms to four causes; they are of great geological age, and existed long before the elevation of the continents, while the appearance of the latter has given rise to currents which are of great significance in distribution; they are provided with powerful locomotor organs; they or their germs may become attached to powerful swimmers, wood, or the feet of swimming birds; and lastly, they are aided by the wind, for when floating on the water they offer a broad surface.

The author then proceeds to discuss the results of recent observations which confirm the idea just enunciated; as examples of geologically old forms, we may take the Protozoa, and especially the Foraminifera, several of which have been found by Brady to be cosmopolitan in their distribution; the Cetacea and perhaps some Cephalopods are good examples of strongly swimming forms; the cosmopolitanism of many pelagic Crustacea and the localization of Cœlenterata are explained by the resistant chitinous shell of the one, and the delicacy of the tissues of the other set of forms; at the same time, some cœlenterate species are very widely distributed.

Influence of High Pressures on Animal Tissues.—M. P. Regnard has investigated the increase of weight in organs and tissues subjected to high pressures (100–400 atmospheres), and he finds a great increase in the quantity of water in the tissues. It is not yet certain whether this is due to water directly entering, or whether it combines with the albuminoids, and, after the removal of the pressure, escapes and infiltrates the tissues.—*Journ. Roy. Micr. Soc., June, 1886.*

Shell Formation in Bivalve Mollusks.—Dr. F. Müller describes the mode of shell formation in Lamellibranchiata. His investigations relate chiefly to Anodonta, Unio and Cyclas, of which chipped-off edges and sections were studied. The decalcification was effected by means of dilute chromic acid; picrocarmine was used for staining, and celloidin was found to be the only satisfactory imbedding material.

The general result of Dr. Müller's research is to corroborate Mathusius in his account of the shell-growth by intussusception and not by secretion. He does not, however, exclude the possi-

bility that apposition of organic elements may occur on the inner surface of the shell, at those places where the shell is permanently united with the body, *i. e.*, from the muscles. The outer margin of the shell, that is the thickened periostæum and the inner surface next the mantle, are always soft. The calcification both of the prismatic and mother-of-pearl layers, is due to small, roundish, irregularly distributed bodies, which gradually increase in all dimensions and become prismatic by mutual pressure.

During the metamorphoses of the young mussel the shell has a fibrillar structure; the lamellation is secondary, probably beginning along with the calcification. The original fibrillar structure is associated with the development and differentiation of the shell-muscles. The organic substance of the shell has a cellular origin.

In their development the fibrils follow the directions of the mantle-muscles. They assume a radial course at the ligament, but elsewhere run parallel to the surface of the mantle, following the direction of the muscle-fibers which run transversely round the animal, just under the epithelium, and which, uniting with the tooth-pad, the pallial line and the periostæum, thus exert influence on the fibrils.

These transverse muscle-fibers aid in the opening of the shell. Those radially disposed on the back of the animal flatten the ligament in contracting, and thus also aid in opening, as those also do which ascend on each side from the foot, and are attached to the tooth or tooth-pad. The muscle-fibers uniting the dorsal muscle insertions on either side, act as adductors. The bundles of cross muscles on the margin of the mantles, which are by one end attached to the shell on the pallial line, and the other to the free portion of the periostæum, effect by their contraction the apposition of the soft-shell margins, and a consequent perfect closure of the shell.—*Journ. Ry. Micr. Soc., June, 1886.*

Mechanism of Opening of the Shell of Mussels.—Dr. J. Panlow has investigated the mechanism of the opening of the shell in *Anodonta cygnæa.* There is a nerve-ganglion 6–8$^{mm.}$ in front of the anterior adductor which gives off several branches. Some of them go to the ganglion on the ventral surface of the posterior adductor. Observations were made by clamping one valve of the shell to a firm board and connecting the other by a silk thread with the short arm of a lever, the longer arm of which works on a slowly rotating drum. An uninjured mussel makes spontaneous movements, the valves being slowly opened a little and closed again more quickly. After separation or irritation of its proper ganglion, each muscle can be studied separately.

The author sums up his conclusions as follows: "Two classes of nerve-fibers supply the adductor muscles—(*a*) motor, causing

contraction, and (*b*) inhibitory, interrupting the contraction and effecting relaxation. The motor nerves of each muscle spring from the nearest ganglion; but all the inhibitory fibers originate in the anterior ganglia. The latter pass to the anterior adductor by the short nerve-branches which pass to it from the anterior ganglia. They reach the posterior muscle through the connectives. The posterior ganglion thus functions as motor center for the posterior adductor; and the anterior ganglia act similarly on the anterior adductor. The motor cells of the ganglia on either side may be stimulated to activity, either by peripheral nerve-fibers (of the mantle or gills) or by certain fibers of the connectives. The anterior ganglia are able to produce relaxation in either anterior or posterior adductors."

ABYSSAL DECAPOD CRUSTACEA OF THE NORTH ATLANTIC.—Professor S. J. Smith reports in the *Annals and Magazine of Natural History* (1886, 187) on the species collected by the *Albatross*.

Altogether 130 species were taken, but only forty-four were found at depths below 1000 fathoms. The first question which arises is, which of these actually inhabited the bottom? Fifteen of them—that is the two Brachyura, the seven Anomura, the Eryontids, Crangonids and Glyphocrangonidæ among the Macrura—are unquestionably inhabitants of the bottom. It is doubtful whether those that are here grouped together as Miersiidæ are deep-dwellers; they are among the most common characteristic forms taken in trawling at great depths, while the structure, *e. g.*, the highly developed black eyes, the comparatively *small* eggs, and the firm integument of *Acanthephyra agassizii* and *A. eximia* are some evidence that they do not normally inhabit the bottom. Pasiphaë and Parapasiphaë seem to be abyssal species, but to be free-swimming; the eight species of Penæidæ which are in the list are undoubtedly free-swimming forms not confined to the immediate region of the bottom, but their relatively small eyes and well-developed ocular papillæ indicate that they are deep-water if not abyssal species.

The author provisionally groups the species into four classes: 1. Species inhabiting the bottom or its immediate neighborhood. 2. Species probably not confined to the immediate neighborhood of the bottom, but showing structural evidence of inhabiting abyssal depths. 3. Doubtful, but probably inhabiting abyssal depths. 4. Species probably not inhabiting abyssal depths.

Many of the species are remarkable for their large size, and there are none that are very small; many are large members of, or even giants, in the families to which they belong. The color of the abyssal Decapoda is very characteristic; a few species are nearly colorless, but most are of some shade of red or orange; bright markings were not seen in any species from below 1000 fathoms. The structure of the eyes is of the highest interest, and

worthy of the most minute and careful investigation, but Mr. Smith has not yet been able to make it. He gives, however, the results of a "superficial examination of the external characters of the eyes." The simplest and most direct form of the tendency to modification is seen in the gradual reduction in the number of the visual elements. Sometimes the eyes are highly modified (as in Pentacheles), and here all the species have probably been long inhabitants of deep water; when the eyes are less modified, or obsolescent, the species are much more closely allied to shallow-water forms. Many Decapods have the eggs large in size and small in number, but this is not true of all; when the eggs are large, development is, as in *Bythocaris leucopis*, abbreviated.

THE MOST SOUTHERN SALMON.—I owe to my friend, Professor Lupton, two specimens of a black-spotted trout from a locality far south of any which has hitherto yielded Salmonidæ. They are from streams of the Sierra Madre, of Mexico, at an elevation of between 7000 and 8000 feet, in the southern part of the State of Chihuahua, near the boundaries of Durango and Sinaloa. The specimens are young, and have teeth on the basihyal bones, as in *Salmo purpuratus*, which they otherwise resemble.—*E. D. Cope.*

THE HABITS OF EUBLEPHARIS VARIEGATUS BAIRD.—This very pretty lizard is the only species of the Eublepharidæ thus far found in the United States. Only one other species of that family is found in America, the *Coleonyx elegans* of Mexico and Central America. I found the former rather abundantly in the rocky hills of the first plateau northwest of San Antonio, in Texas, but did not observe it in that region north of that point either on the Guadalupe or Llano. It is found in holes under stones, towards evening, and generally in pairs, a peculiarity I have not observed in any other lizard. Its manners are also peculiar. It carries its thick tail coiled vertically on one side of its back like the spitz dog. Its movements are quick but feeble, and its short legs forbid the speed of other lizards. Coleonyx is one of the few genera of Gecconidæ which have eyelids, and as these are thick, and their movement in winking is slower than in other lizards, the physiognomy is quite peculiar. When handled, this species chirrups and squeals feebly like a singing mouse. One specimen which I took was about to shed its skin, so I placed it in a jar to observe the process. This took place in the night, for next morning it was so clean and its color so bright, that it looked as though gotten up for some special occasion. As no trace of the skin could be found, I suppose that it ate it, after the manner of the Batrachia. In life, the colors are very elegant; the pale cross-bands are citron-yellow, and the brown ones bright chestnut. The inferior surfaces and all parts of the limbs are flesh or rose color.

A specimen recently sent to the Smithsonian Institution licks

the end of its nose with its tongue like a dog. Respiration is carried on by means of both the intercostal and hyoid muscles.—*E. D. Cope.*

THE SENSE ORGAN IN THE PINEAL GLAND.—The suggestion of Ahlborn and Rabl. Ruckard that the pineal gland is the remnant of some organ of special sense present in some primitive Vertebrata,[1] has received confirmation from the studies of Von Graaf and Spencer. The former finds a rudimental organ of sense in this part of the brain of the slowworm-lizard (*Anguis fragilis*), and the latter, who works in the biological laboratory of the University of Oxford, finds a similar organ in the *Sphenodon punctatus*. The organ includes a lense, and is of the invertebrate type, *i. e.*, the rods are turned towards the light and not away from it.

These observations render it probable that certain extinct relations of Sphenodon, the saurians of the family Diadectidæ (order Theromorpha) of the Permian epoch of North America, had this pineal sense-organ highly developed. The frontopariëtal fontanelle is larger than in any other reptiles, and the cast of the surrounding regions shows various peculiarities (see Proc. Amer. Phil. Soc., 1885, p. 236).

THE VERTEBRÆ OF SPHENODON.—In the May number of the AMERICAN NATURALIST (p. 466) Dr. G. Baur mentions that "nobody will find the separate part of ossification of the prezygapophyses in the cervical vertebræ of Sphenodon," the figures of which I gave in my work, Fauna der Gaskohle, Tab. 70.

To facilitate the understanding of my drawing, I gave the exact dimensions of the object carefully drawn with the camera lucida. The seven cervical vertebræ are 27^{mm} long, and on the third, fourth and fifth the ossification on the tip of the prezygapophysis[2] is clearly seen.

The object is in the zoological cabinet of the Boh. University at Prague, and can be shown to any scientific man.

In regard to the question whether that is an equivalent of the pleurocentrum or not, I gave on p. 52 my opinion with caution as a probable way to explain the difficult question: What has become of the pleurocentrum in Sphenodon?—*Dr. Anton Fritsch, Prague, Bohemia, June, 1886.*

THE RATTLESNAKE IN NEW ENGLAND.—The following notes on the recent occurrence of rattlesnakes in Southern New England, are inserted in order to call out notes and information from others as to the occurrence of this reptile at or near its northern limits of distribution. We have been told that rattlesnakes are still occasionally killed in Connecticut near the Rhode Island border.

[1] See remarks on the possible monoculous character of *Bothriolepis canadensis*. NATURALIST, 1885, p. 291.

[2] The thorax of the specimen being 125^{mm}.

It is generally stated that the last rattlesnake was killed in Rhode Island twenty years ago, but we are informed by Professor Battey that one was killed at Tiverton, R. I., within a period of four years. Its skin is now in the museum of the Friends' School, at Providence. Mr. Henry H. Buxton, a member of this school, from Peabody, Mass., gives us the following statement regarding its occurrence at that locality:

"In South Peabody there is a rock called Rattlesnake rock, surrounded by woods in which there are a great many snakes, including the rattlesnake. During the last year three or four have been killed by different persons. They confine themselves to the part of the town which is the most rocky and slightly elevated. In the winter they get under this rock and go to sleep. One man who lives in the vicinity found one on his door step sunning himself. He says money wouldn't hire him to go near the rock during the summer. George Foster, the son of Gen. Foster, of Revolutionary fame, bought one to keep as a pet, but one night when he came home he went to get a match, but instead of a match he got a bite. He happened to be full of liquor at that time, so it did not kill him. Last summer one was killed with eleven rattles. It is very unsafe for anybody to go into the woods in this part of the town in the summer, especially when berries are ripe. The snakes are about the color of the ground and sticks, and a person gets right onto them before he is aware of it." Rattlesnakes are still common in the Milton hills, near Boston, and at Hyde park.—*A. S. Packard.*

Zoological News.—*General.*—A Natural History Society has been founded at Yokohama. At the first meeting, in April of the present year, Professor Milne spoke of the difference between the fauna of Yezo and that of the other Japanese islands. In Japan they have the monkey, the sheep-faced antelope, the bear and the pheasant, while on the other side of the straits there is neither monkey, pheasant nor antelope, and the bear is a different species.——M. H. de Varign (*Revue Scientifique*, April 3d,) details the result of experimental researches upon the muscular contraction of invertebrates. The graphic method was employed, and Crustacea, mollusks and echinoderms were submitted to examination. The variations observed in the latent period, whether in smooth or striated muscle, proved to be of the same kind and to be subject to the same influences as those of vertebrate muscles. The form of contraction follows the same rule as the latent period, its duration in the Crustacea and the scorpion is in some cases even shorter than in vertebrates, but in Dromia and Maia it is relatively slow, and very slow in Rhizostoma. A short latent period is followed by a short contraction. Tetanus, normal and rhythmic, the paradox of Weber, and other muscular conditions were studied and the general result was to prove that there

is not the fundamental difference between smooth and striated muscles in the invertebrates that has been attributed to the two forms in the vertebrates. The smooth, voluntary muscles offer every intermediate phase of duration of contraction.

Worms.—The thesis by which M. Francois obtained the degree of doctor of natural sciences was entitled "A contribution to the knowledge of the nervous system of the Hirudinea." The nerves connecting the ganglia have in Branchellion a neurilemma and three nervous cords, and there is no trace of a medullary canal. The cellules of the ganglia are arranged in six follicules, and occupy the inferior and lateral regions of each ganglion, two ventral and four lateral.——Adam Sedgwick contributes to the February issue of the *Quart. Jour. Mic. Science* an article upon the development of the Cape species of Peripatus. The segmentation is apparently complete, and the endoderm cells come at first without a distinct nucleus.

Mollusca.—The appendages of the female organ of reproduction in the gasteropods are usually distinct and placed along the line of the oviduct, but in Doris they are united into a single mass. This is difficult to dissect, but by taking advantage of the spawning period, M. E. Bolot has been able to identify the different points of the gland where the eggs receive the accessory parts necessary to their perfection.

Fishes.—S. E. Meek and R. Newland (Proc. Acad. Nat. Sci. Phil.) give a review of the genus Esox. They allow five species, viz: *Americanus, vermiculatus, reticulatus, lucius,* and *masquinongi.* The same authors review the genus Scorpæna, of which they allow eleven species, all except two of which are American.

Reptiles.—W. Baldwin Spencer (*Nature,* May 13) describes a curious organ which he characterizes as "the parietal eye of Hatteria," an eye which is originally part of the epiphysis. The epiphysis, which seems to arise as a hollow outgrowth from the roof of the third ventricle, becomes in both reptiles and Amphibia divided into two parts, a proximal one remaining in connection with the brain, and a distal, bladder-shaped structure, the two in most cases becoming completely separated. In *Anguis fragilis* this distal part develops into a structure resembling a highly-organized invertebrate eye, but without a nerve. In Hatteria this portion forms an eye with capsule and lens as in Anguis, but a nerve is present also. The organ, deeply embedded in connective tissue, is now useless. Iguana, *Chameleo vulgaris* and *Lacerta ocellata,* have a similar parietal eye.

Birds.—Those interested in the migrations of birds should refer to the series of articles by M. Oustalet in recent issues of the *Revue Scientifique.*——Professor R. Collett recently communicated to the Zoölogical Society of London an account of a hybrid which occasionally exists between the willow grouse (*Lagopus albus*)

and the black grouse (*Tetrao tetrix*). Most of the thirteen specimens examined were males.

Mammals.—Mr. Frederick True, in a letter to *Science*, asserts that he has found characters by which *Lynx canadensis* can be distinguished from *L. rufus* and the other Southern varieties. Examination of over sixty skulls showed that in all examples of *L. canadensis* the anterior condyloid foramen is *not* confluent with the foramen lacerum posterium, and that the visible portion of the presphenoid is flask-shaped, the convexity in front. In *L. rufus*, *maculatus* and *fasciatus* the two foramina are confluent as in the cats generally, and the visible part of the presphenoid is sagittate or linear. Mr. True, therefore, believes that there are two species of American lynxes, and that the confluence of the condyloid and lacerated foramina cannot in future be regarded as a distinguishing character of the Æluroidea.——Walter Heape (*Quart. Jour. Mic. Science*, Feb., 1886) contributes an article upon the development of the mole (*Talpa europea*), the ovarian ovum and the segmentation of the ovum. The epiblast of the vesicle and of the embryo is formed from the whole of the outer layer and by far the largest proportion of the inner mass of segments. The hypoblast is formed from the small remaining portion of the inner mass, and the mesoblast, subsequently, from both epiblast and hypoblast layers. Thus the division of the segmentation spheres, by Beneden, into epi- and hypoblast spheres from the time when the two first segments were formed, is incorrect.——Dr. O. Finsch has recently described a new species of wild pig (*Sus niger*) from New Guinea.

EMBRYOLOGY.[1]

The Metamorphosis of the American Lobster, Homarus americanus H. Milne-Edwards. — The changes which the young lobster undergoes during the first six or seven weeks of its free existence, as a pelagic organism, constitute a veritable metamorphosis, which is apparently accomplished in the course of six ecdyses, or changes of the exoskeletal investment of the body. These molts, or ecdyses, occur at intervals of from four to fifteen or more days, if the larvæ are well fed. At each ecdysis a complete renewal of the exoskeleton occurs; the old cast skin being quite thin and transparent up to the fifth ecdysis, and retains the form of the body at the time of molting. The old skin is ruptured along the median dorsal line of the cephalothorax and at the point where the latter joins the abdomen; the tail is withdrawn after the head.

Inasmuch as some Arthropods undergo an ecdysis within the egg, the advanced eggs of the lobster have been carefully examined to determine whether a molt took place at the time of

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

hatching. Such is not the case, since the thin distinct inner membrane ruptured at the time of hatching is not a molted larval skin, but an egg-membrane which was developed within the ovary. This egg-membrane is invested at the time of oviposition by a much thicker coating of a viscid substance, which is continued into the flexible threads by which the eggs adhere together in clusters and are suspended to the setæ which fringe the abdominal appendages of the adult female. At the time of hatching the young hang for a short time more or less firmly to this inner membrane, grasping it with the rostral spine and telson.

The first stage.—This stage is the one which the young lobsters present at the time of hatching. They are essentially Schizopods during this and the succeeding three stages. During this stage the young have no abdominal appendages, and swim about as pelagic larvæ by the help of the outer rami or exopodites of the six hinder cephalothoracic pairs of appendages; the endopodites or inner rami of the six hinder cephalothoracic appendages are not used in locomotion during this stage, and are almost wholly subservient to the purpose of prehension. The telson is a single, very broad, somewhat triangular piece, with strong spines at either posterior angle. The total length of the larva at this stage is eight millimeters.

Second stage.—This stage follows the preceding abruptly and is preceded by an ecdysis three to six days after hatching. This ecdysis or molt must therefore be regarded as the first one. Upon its accomplishment the larva has increased 1.5^{mm} in length, as the young lobster is now 9.5^{mm} long. The second to the fifth abdominal somites have also acquired appendages.

Third stage.—This follows the preceding, and is preceded by a second ecdysis about the tenth to the fifteenth day after hatching. The penultimate or sixth abdominal segment also acquires a pair of biramous, lamellar appendages, which fold alongside of and reinforce the telson. The young animal now measures 11.5^{mm} in length.

Fourth stage.—This one succeeds the preceding, and is preceded by a third ecdysis on the fourteenth to the eighteenth day after hatching. The young lobster differs but little, except in size and the proportional strength of the successive pairs of appendages, from the foregoing stage, and now measures 13^{mm} in length. This and the preceding stage was apparently confounded by Professor S. I. Smith,[1] who seems to regard the two as representing but a single phase of development.

Fifth stage.—This phase of development of the lobster transforms the young creature at the end of about the third week very abruptly into a type very closely resembling the adults, and is

[1] The Metamorphoses of the Lobster and other Crustacea. Report of the U. S. Fish Commission, Part I, 1871 and 1872, pp. 522–537, pl. IX. (Figs. 38 and 39 of plate IX of that report represent very accurately the first and third stages.)

heralded by the fourth ecdysis or molt. The telson now closely resembles that of the adult, and on either side of it the broad lamellæ of the exopodites of the appendages of the penultimate abdominal segment become distinctly segmented for the first time into two movably articulated pieces. The flagella of the antennæ and antennules now become much longer, the former being as long as the cephalothorax. The appendages of the second to the sixth abdominal segments inclusive, are now much more strongly developed than hitherto, and together with the telson constitute the only organs of propulsion in swimming. The schizopodal characters of the six hinder cephalothoracic appendages have almost entirely disappeared at this stage; the exopodites of those appendages are almost entirely absorbed at the time of the fourth molt, and remain for a time as blunt, rounded tubercles near the bases of the legs, on the upper aspects of the latter. The first pair of abdominal appendages have not yet appeared; the symmetrical chelipeds are now well developed and are not carried in a pendant position, as in the preceding stages, but in that in which they are held by the adult, and when swimming they are extended forwards and parallel with each other. The young lobster now measures 14^{mm} long from the tip of the rostrum to the end of the telson; 16^{mm} from the tips of the extended chelipeds to the end of the telson; 18^{mm} from the tips of the extended antennæ to the extremity of the telson. The young lobster, towards the close of this stage, during the fifth week, becomes less partial to its earlier pelagic mode of life, and remains on the bottom a great part of the time. The color is now a bluish-green, with more or less brown in some cases, so that the animal is no longer so transparent as during the preceding stages.

Sixth stage.—This stage is attained between five and six weeks after hatching and, like the foregoing, is preceded by an ecdysis. The latter, unlike the previous molts, is hard and brittle, bluish in color and retains the form attained by the animal at the end of the preceding stage. The young lobster now measures 19^{mm} from the tip of the still bifid rostrum to the tip of the telson; 22^{mm} from the tips of the extended chelipeds to the end of the abdomen. The antennæ are now considerably longer than the cephalothorax, or proportionally almost as long as those of the adult; the total length of the animal from the tips of the extended antennæ to the end of the telson is now 29^{mm}. One of the chelæ is now also perceptibly larger than the other. The animal has not yet, however, assumed the adult condition, as there are still no appendages developed on the first abdominal segment.

Seventh stage.—This is also preceded by an ecdysis, and the young animal now measures 22^{mm} in length from the tip of the rostrum to the end of the telson; 36^{mm} from the tip of the antennæ to the tip of the telson. The pair of appendages on the first abdominal ring have now appeared as very short rudiments which

are quite unlike those of the adult both in form and size. The modifications of this pair of appendages, indicating the sex of the individual, have not yet appeared, however, and are probably not developed until after the next or seventh molt, when the young lobster entered upon the *eighth stage* of its free existence. There is a very decided inequality in the size of the two great "claws" or "pincers" at the end of the seventh stage. The young animal now manifests a more strongly marked disposition to remain on the bottom than during the preceding stage. This last-described stage is attained in about seven weeks after hatching.

It will be seen that as to the number of stages my observations are not in accord with those of either Smith or of Dannevig.[1] The work of G. O. Sars, on the development of the European lobster, I have not seen, but the large amount of material which I have had the opportunity to study in a series of tanks, under conditions admitting of very little chance of error, in the United States Fish Commission station at Wood's Holl, leads me to think that with the precautions which have been taken, I have not confounded or subdivided any stages, as I believe an alcoholic series which has been preserved of the stages above described will amply prove. With a slight rise in the temperature of the water, and an abundance of food, the fourth molt, or fifth stage, may be reached in twelve days, as later expericnce shows.—*John A. Ryder.*

THE MONSTROSITIES OBSERVED AMONGST RECENTLY HATCHED LOBSTERS.—At Wood's Holl a few double monsters were hatched out amongst the normal lobster larvæ. These monstrosities were all the more interesting from the fact that they proved in the most striking manner that double monsters must be developed in the meroblastic egg of the lobster in much the same way as in that of fishes.

Four forms of double monsters were observed:

First type.—This one had no eyes; the cephalothoraces of the two embryos were completely fused together laterally and anteriorly, while their abdomens were separate and diverged at a wide angle from each other.

Second type.—This form had a single eye anteriorly and on the line where the cephalothoraces of the two embryos were fused together; in other respects this form resembled the preceding.

Third type.—In this form the cephalothoraces of two embryos were fused laterally and anteriorly, and there was no median eye as in the preceding type, but a pair of eyes, the one representing the left eye of the left embryo, and the other the right eye of the right embryo, were developed.

Fourth type.—In this form the cephalothoraces of two embryos

[1] Beretning over Virksomheden ved Udklaekningsanstalten for Saltvandsfisk. 12mo. pp. 39, pls. 2. Arendal, 1885.

were fused together along their anterior dorsal aspects. There were four eyes developed, two to each embryo, and two distinct sets of mouth-parts and biramous, locomotive appendages.

In this last form the two embryos adhere together dorsally, and the two systems of limbs of the two nascent lobsters, which have obviously developed from a single blastoderm, enveloping one yolk, are directed away from each other. This relation of two perfectly formed embryos in the same lobster egg is exactly the reverse of that which is observed in vertebrates. For example, two embryo fishes which had been developed from the same blastoderm would, if primarily formed at exactly opposite sides of the blastodermic disk, finally be found to adhere together by their ventral aspects, so that their backs would look in opposite directions. These interesting data may in part be interpreted by the well-known fact that the neural aspect of an arthropod is ventral, while the neural aspect of a vertebrate is dorsal. This does not, however, afford a complete interpretation, since we find, not only in the case of a double vertebrate, but also in that of a similar invertebrate monster, that the median or unpaired organs of the two are often fused. This is the case in the double monsters of the lobster of the first, second and third types. Inasmuch as such structures as the alimentary canals and hearts of two such conjoined embryos are so fused, the question immediately arises, How was this accomplished? The answer seems to be that the fusion took place coincidently with the process of gastrulation and the subsequent gradual formation of the organs of the two embryos. This view of the matter is further substantiated by the fact that the four types described represent as many degrees of fusion or union. The question which now arises, however, relates to the way in which these different degrees of fusion of the two embryos were developed.

This may be explained, it appears to the writer, on *a priori* grounds, in the same way in which the different degrees of fusion or concrescence of double fish embryos were interpreted by Rauber, and since verified by other observers. That is to say, if two gastrulæ were developed at the edge of the same blastodisk, the degree and manner of their fusion would be determined by the width of the angle at which the two embryonic axes were primarily inclined to each other. This principle probably applies also in the case of the double monsters developed in the eggs of lobsters, and further extends the application of the doctrine and theory of concrescence.—*John A. Ryder.*

PSYCHOLOGY.

A CURIOUS SUPERSTITION.—A neighbor, residing on a small farm near me, has, on several occasions, spoken of his experience with "hog mice." He came to this country many years ago from Northamptonshire, England, where he had often seen these strange animals. They are also occasionally seen by him here in Iowa. This mythical rodent is about the size of a barn mouse, but its striking peculiarity, as to outward appearance, is, that it has a head and face fashioned exactly like that of a hog. It is a very "uncanny" little beast. If it merely runs across the body of a sleeping person, or of a domestic animal, such unfortunate person or animal will be grievously afflicted with lameness or soreness wherever the mouse sets down one of its little feet! Serious disability often comes from the touch of the "'og mouse." In some extreme cases the affliction is well-nigh incurable, and may even last a life-time.

My old friend said that it was no hearsay matter with him. He "had seen 'og mice both in Northamptonshire and 'ere in Hamerica." One of his colts "was disabled by a 'og mouse running hover hit, and was a long, long time getting well."

A striking peculiarity of the hog-faced *mus*, according to my old friend, is that it is never seen at rest, but is always "on a dead run," as if fleeing from pursuit.

I tried to reason him out of this absurd belief, but he stoutly asserted that he had often seen these animals and witnessed the deleterious effects of their presence; that his knowledge was positive, and that there could be no mistake about the matter.

I have consulted "Brande's Cyclopædia of Popular Antiquities," but find no reference to this strange superstition, which, therefore, must be merely local. It is certainly a very singular one, and worthy of being "in books recorded" with others of its class.—*Charles Aldrich, Webster City, Iowa, July 1, 1886.*

THE COPPERHEAD AND OTHER SNAKES.—A copperhead in good condition was recently placed in a cage in the reptile department of the Smithsonian Institution, in which were also confined a *Heterodon platyrhinus* (hog nose) and a *Tropidonotus sipedon* (water snake). The two harmless species showed great fear of the copperhead, retreating promptly to the part of the cage most remote from their dangerous visitor. The behavior of the two snakes differed. The water snake, although the more pugnacious of the two where the human hand is in question, endeavored to hide, and laid perfectly quiet in such depressions as he could find in the sand of the floor. The Heterodon, on the other hand, inflated his lung so as to double his usual diameter, and expanded the ribs of the anterior fourth of his length, and hissed loudly with both inspirations and expirations. He also burrowed into the sand in the bottom of the cage, and thus covered his head

with a pile of that material, which he raised in the air. In this singular condition he made the greatest possible display of himself in front of the copperhead, as though to intimidate him. He maintained the inflation for two days, or until the copperhead was removed, as if aware that a bite into a bag of wind would be almost innocuous. The copperhead acted as though master of the situation, but could not be persuaded to bite, though considerably irritated.—*E. D. Cope.*

ANTHROPOLOGY.[1]

CHILD GROWTH. — It is a matter of almost daily notice that the children about us are changing, growing, yet of the laws governing this growth, we think but little, if, indeed, we give them any thought.

If the body develops normally it receives but little attention and no study from mothers. To the mind we give more heed, although even that receives but a small amount of care until the child has advanced far on the pathway of knowledge.

There are laws governing the growth of body and mind which go hand-in-hand, and which should be known to, and studied by, every custodian of children, be it as parent, teacher or guardian. No need to leave our homes, families or schools to study these laws, for right there is the veiled Isis whose study will lead us to higher planes, where, if we would work with half the zeal displayed in the merely ornamental, we could make contributions of true value to anthropology, as well as secure to ourselves and children knowledge of priceless value. This mine of wealth is our children, the beloved of our hearts, the treasures of our lives.

It is the systematic study of their growth, physical and mental, that I hope we may undertake together.

The study of my little daughter began in 1881, shortly after her birth, when, looking at her tiny hand with the wondering love of a mother over her first born, I outlined the rosy palm with pencil and paper, adding a lock of the silky fuzz, not so much to show the character of the hair, perhaps, but because the drawing looked rather naked. Imagine my surprise later to find just such an outline for scientific measurement; also, to learn the great importance of the color and quality of the hair. (Professor Huxley, in his Anatomy of the Vertebrate Animals, divides his races of mankind into two primary divisions, according to the quality of the hair, viz: The Ulotrichi with crisp and woolly hair, and the Liotrichi with smooth hair.) I then added the weight at birth, then the time of her first smile, in short, the record grew until I have a journal which has much in common with the study of anthropology.

Every thinker admits that in the human, as well as other ani-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

mals, are hereditary virtues as well as vices. Children with suicidal tendencies entirely prenatal, others with thievish propensities given before birth. Then, too, we find the sons and daughters of pure and upright parents with noble souls and lofty aims. If we had a record of ourselves, thereby affording us a knowledge of our hereditary tendencies, could we not more intelligently meet, or perhaps anticipate, the needs of our children, more readily counteract evil propensities and recognize the good?

We do not realize the value of this work, nor yet the great advantages we have to collect data.

Scientists have worked hard, under most trying circumstances, to create an interest in this kind of work as well as to collect data for statistics. Francis Galton, known the world over as a leading anthropologist, prepared a set of cards and hired men to go about England paying people a small sum for each child they would allow them to weigh, measure, take age, color of hair, eyes, etc., that he might get statistics for race characteristics. Fröbel (that mind which saw the needs of childhood and has been such a blessed help to mothers and children) advised mothers to keep a record of the growth of their children.

This record is not a difficult task, and can be best kept in the quiet of home life. It consists of gathering and recording the little daily incidents, surroundings, tendencies, games, pleasures, sorrows and sicknesses of ourselves and children; also the height, weight, color of hair and eyes, strength of sight, hearing, also resemblances. The food on which the child is fed, frequency of meals, at what age did child exhibit consciousness, as notice the prick of a pin, follow a light with its eyes; at what age did it walk, talk, and what words did it use. Then, as the child grows older, to name the character of its play, amount of exercise, of memory, imagination.

The height should be taken with bare feet, standing against the wall, laying a carpenter's square across the head and marking, then measuring with an ordinary tape measure. In the case of an infant, lay it on the back, stand a square against head and feet, and measure distance between.

The sight is tested by reading type of different sizes at given distances; hearing by the distance in feet the ticking of a watch can be heard; knowledge of colors by a few skeins of worsted.

Older countries appreciate the value of these researches more than Americans, hence we find in England and France more systematic effort in that direction. In this connection I would not be understood as undervaluing the work of American scientists, noticeably the researches of Dr. Bowditch, professor of physiology of Harvard Medical College; also of Dr. Peckham, teacher of biology of the High School of Milwaukee, Wis., whose articles, entitled "The Growth of Children," are quoted as standard authorities, particularly in England. The only public

effort in our country to collect such records, that I have been able to find, is a circular issued in 1881 by the Education Department of the American Social Science Association, which contained a short register for the physical and mental growth of children, requesting parents to send them a duplicate. As I could find no circular since that of 1882, I wrote to the secretary, Mrs. Emily Talbot, of Boston, to know if they continued the work, to which she replied under date of January 4th, 1886: "The Social Science Association only pointed to the open door, hoping and expecting that the right sort of a scientific enthusiast would sometime enter in."

The British Medical Association has a Collective Investigation Committee, whose object it is to collect such data as any mother can furnish. In France the measuring and weighing of babies is a matter of such common practice that in shops devoted to babies' wares and wardrobes, one always finds weighing machines, which are regarded as a necessary part of every baby's outfit. Lothrop, and Lee & Shephard, of Boston, each publish books for mothers to keep registers of their children's growth. Dr. Elizabeth Stow Brown, of the New York Infant Asylum, who has seventy children under her care, is recording their development.

What may we learn from these facts?

First. That there is a need in the world of such information.

Second. That women are best fitted to collect this valuable material.

Third. That fathers and mothers stand ready to do the work systematically, asking only a guiding hand.

Since the above article was read the Woman's Anthropological Society has decided to begin the work above described, and, in the main, to adopt the system used by the Collective Investigation Committee of the British Medical Association, who publish a book with the questions to be answered, giving full directions for taking measurements, weights, testing sight and hearing. These books are to be kept in duplicate by the parents, and every year the duplicate to be sent to the society to become a part of their records, thus furnishing material of priceless value for scientific study, and securing to the parents and child a systematic record, both valuable and interesting.

There are many who have thought of this kind of work and are, perhaps, keeping records, who are unknown to us. From such we cordially invite suggestions, and where our object is not plain, it will give us pleasure to answer questions. The success of this work depends largely upon the interest taken by mothers, and as there is no doubt of the need of such work at their hands, we must earnestly request them to communicate with us.

Let not the fact that you did not begin in infancy of your children deter you. Let their age be what it may, the record will be valuable.

All correspondence should be addressed: The Corresponding Secretary, Woman's Anthropological Society, Washington, D. C.

PARTIAL LIST OF QUESTIONS. (To appear later in book form.)

1. Give full name.
2. Previous health of mother whether under any especial mental or physical stimulus, as fright or sickness)?
3. Physical peculiarities (if any, as "mother's marks")?
4. Weight (naked)?
5. Color of hair?
6. Healthy or ailing?
7. Good-natured or fretful?
8. At what age did the child exhibit consciousness, or pain?
9. Follow a light with its eyes?
10. Sit alone?
11. Creep?
12. Walk?
13. Speak, and what did it say?
14. Character of food?
15. Give average number of hours of sleep in twenty-four hours.
16. State diseases, if any.
17. At what age did child enter school?
18. Amount and character of exercise.
19. Sports.
20. Playthings.
21. Mention any marked artistic capacity.
22. State of memory, retentive or unreliable?

—*Clara Bliss Hinds.*

SKULL OF ADULT WITH FRONTAL SUTURE.—The following description of a cranium presenting some unusual and abnormal features may be considered not unworthy of record. It is the skull of a white man of about forty years of age, and was found four years ago by a member of my family, a young medical student, on the north-west coast of Lake Erie, where the body had originally been washed ashore and had been buried; the action of the waves during storms having finally unearthed the bones, the greater part of the skeleton was recovered. Diligent inquiry failed to disclose any information in regard to the unknown individual's nationality or history. It is possible he may have been lost overboard from some passing vessel. Nothing peculiar as to his person was noticed by those who buried him.

The dimensions of the cranium, here given, are expressed in inches and decimals of an inch: Circumference, 20.82; length, 7.43; breadth, 5.60; height, 4.83; breadth of frontal, 5.13; frontal arch, 12.25; pariëtal arch, 12.80; occipital arch, 11.12; longitudinal arch, 14.72; length of frontal, 5.35; length of pariëtal, 5.25; length of occipital, 4.12. The latitudinal index is .753, which would place it in the medium or mesaticephalic division. The altitudinal index is .650, while the position of the foramen magnum affords an index of .480.

One of the peculiar characteristics of the skull is the presence of a frontal suture. This suture, as is well known, is usually obliterated in the adult, the frontal bone forming one piece. In

the case before us it is well marked and fully developed throughout, dividing the frontal bone into two lateral halves. The serræ or dentations are quite abundant for the greater part of the suture, and are particularly frequent in the upper portion. The coronal suture in the vicinity of the anterior fontanelle remains unclosed, permitting a slight movement of the frontal bone.

On the sagittal suture, at its junction with the coronal suture (near the position of the anterior fontanelle), occurs a wormian bone of quadrilateral form, .65 of an inch long, by .2 of an inch wide. Back of this the entire sagittal suture is completely closed and obliterated, with the exception of a slight indication of its existence for about one-quarter of an inch at its junction with the lambdoid suture; a shallow wavering depression along the rest of its former course being all that remains to mark its position.

In the lambdoid suture, which is deeply indented, five wormian bones are present. With the exception of one of them, which is triangular in shape, situated at the summit of the occipital bone, they are, like that on the sagittal suture, quadrilateral in form. The largest of these is .75 by .57 of an inch; the smallest is .6 by .3 of an inch. The former presents the curious feature of two or more wormian bones within a wormian bone. Usually wormian bones are of triangular form, which gives them the name by which they are also called, viz: *Ossa triquetra*, or, *triangularia*. In the wormian bone on the sagittal suture, the long diameter is with the general direction of the suture; but those bones in the lambdoid suture have the long diameter at right angles to the direction of the suture.

Though the skull is small, it is heavy for its size; and the structure of the bones is solid, massive and unyielding. This is the more worthy of remark from certain indications which would seem to point to defective or abortive ossification. The occlusion and obliteration of the sagittal suture would appear to have found compensation or relief in the permanent establishment of the frontal suture; and also in the remaining open of that part of the coronal suture in the neighborhood of the anterior fontanelle. The occurrence of the wormian bones is also corroborative of defective ossification, the membranous intervals left in the process of growth being filled in by these supernumerary bones, developed from separate centers.

While the coronal region is not only flat, but slightly depressed, the forehead is straight, and the frontal eminences, though not especially prominent, are well developed, as is also the superciliary ridge, the glabella being distinct. The occipital protuberance is a decidedly pronounced feature. Some of these facts point to a similar origin.

The remaining bones appear to be well made and of fair shape. The femur, tibia, humerus, etc., are finely proportioned and of strong build, though the man was of short height. The stature,

as obtained by me by computation from the length of the femur, using Humphrey's method, is 5 feet 3½ inches.

Owing to the absence of the maxillaries, the nasal and malar bones, and the zygomatic arches, I was prevented making several interesting and important measurements.

In this connection it may be well to remark that synostosis is not always productive of deformity, and that the age at which the lesion occurs has much to do with the gravity and character of the result.—*Henry Giltman, Detroit, Michigan.*

THE BATEKES.—A small but exceedingly rare collection brought to the National Museum by Mr. Tisdel, makes the paper of M. Guiral doubly interesting. In Stanley's "Congo" will be found a map locating this interesting people. The Batékés are an agricultural people, locating their villages near water-courses, upon fertile areas, surrounded by sandy wastes. Their crops are palms, manioc, arachids, millet and maize. M. Guiral speaks with pathetic eloquence of the discomforts of smoke and vermin in these palm-leaf habitations.

The Batékés are tall and meager, and very dark; eyes bright and mobile, voices weak but supple. Their clothing is a short petticoat, or a breech clout. They wear the hair short and plaited in little braids, following each his own design. They adorn the hair with feathers and beads. They grease their bodies with palm oil and chip their front teeth.

The women are the farmers, and perform their work with a simple hoe of native manufacture. For domestic animals they have goats, chickens, pigs and dogs. The music of the Batékés consists of a gourd rattle; a calabash pierced with an opening in which to blow at the same time that the object is struck with the hands; a kind of fife, three-stringed guitar, castanets, a tambour made of hollow wood covered with goat skin, and a species of zither formed like a bow and arrow. In the last-named instrument a bow has two strings of different lengths attached to an arrow shaft. Instead of a point the arrow has a broad disk for a head, which the player places against his breast. By drawing the bow towards him the player has virtually four strings, which he can tighten *ad libitum.—Leon Guiral, Rev. d'Ethnog., v, 135–166; also see id. iv, 160–168, and iii, 550–555.*

THE NICOBARESE.—The inhabitants of the Nicobar islands consist of two races, the natives of the interior, of pure descent (with certain Mongolian affinities), isolated from a remote period; and the natives of the coast, exhibiting all the characteristics of a mongrel Malay race. The inland people are known to the coast tribes as Shom Peir (*Shom*, people, and *Peir*, the tribe designated). They are fairer than the Malays and straight-haired. The coast inhabitants show an admixture of Burmese and Siamese blood, the former through regular traffic, the latter through wrecks cast

ashore. A very interesting invention for recording the number of days, etc., is that of bending back a strip of bamboo until the requisite number of cracks were made on the surface. The coast people chew the betel until the teeth become coated with a thick, hard mass, protruding from the gums so as to make it impossible for the lips to meet.

The Shom Peir boil their food in pots or sacks made of bark from three varieties of trees.—*E. H. Man, J. Anthrop. Inst., xv, 428–451.*

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SCIENTIFIC NEWS.[1]

—As we have been asked for the best cement for use in making aquaria, we extract from the *English Mechanic* the following receipt: "This glue is employed where the materials are exposed to the influence of wet. It cements not only wood, but glass and metals. It is made by dissolving, by heat, one part of pure india-rubber in naphtha, the india-rubber being cut very small. When melted, two parts of shellac are added, and the melting continued until the whole is well mixed by occasional stirring or shaking. While hot, it is poured on metal plates to cool. Before using, it requires to be liquefied by heat, and quickly applied with a brush, as it soon hardens."

—The first number of a new German fortnightly journal of anatomy, entitled *Anatomischer Anzeiger, Centralblatt für die gesammte wissenschaftliche Anatomie*, appeared June 1st, 1886. It is edited by Professor Karl Bardeleben, of Jena, and is published by Gustav Fischer. Besides short articles and abstracts of longer ones, it gives the titles of new papers and works on anatomy with technological notes and personal news. The price for 1886 is six marks.

—Professor H. Fol and E. Sarasin read a paper before the French Academy of Sciences, May 3d, on the penetration of light into deep sea-water. From their experiments, reports *Nature*, it appears that layers at a depth of 300 meters are illumined every day for the whole time that the sun remains above the horizon. At 350 meters light penetrates for at least eight hours daily. Even after sunset the actinic rays seem to reach considerable depths.

—A late number of the *Investia*, of the Russian Geographica[1] Society, contains a letter from M. Prjevalsky, dated Lob-na, January 29th, 1885, in which he announces the discovery, in the vicinity of Has, of a new species of sheep, which he calls *Ovis dalailamæ*. At Lob-nor he was to spend the month of February in studying the migrations of birds.

[1] Edited by Wm. Hosea Ballou, 265 Broadway, N. Y.

—Dr. C. O. Whitman, now connected with the biological laboratory of Mr. E. P. Allis, Jr., is to edit an American Journal of Animal Morphology, to be issued in two parts a year, at $6 a volume, the first number to appear in January, 1887. The publishers are Ginn & Co., of New York, Boston and Chicago.

—Baron Mikluho-Maclay has just returned, says *Nature*, to Odessa from his journey to New Guinea, which has lasted two years. He has brought a large collection of rare fishes, lizards, snakes, insects, etc., packed in twenty-two boxes.

—While the subject of hybridity is attracting renewed attention from biologists, it is interesting to note the communication to the London Zoölogical Society of a case of hybridism between *Oris hodgsoni* and *O. vignei.*

—Capt. D. H. Murdoch, of Camp Douglass, Utah, was drowned June 6th, in crossing the Grand river en route to a camp in Southern Utah. He was enthusiastically devoted to natural history.

—Dr. W. J. Hoffman, of the Bureau of Ethnology, has received the gold medal of the Reale Società Didascalica Italiana, at Rome. The Society is mainly composed of anthropologists.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Oct. 6, 1885.—Mr. Morris remarked that four successive ideas seem to have ruled in the development of animal forms, viz: (1) soft bodies; (2) armored bodies; (3) swift motion; (4) intelligence. It is probable that the primitive animals were all soft-bodied, with only the tentacle, thread-cell, etc., for their weapons. The oldest fossils are for the most part those of armored animals; but later on swift flight and swift pursuit were the chief methods of attack and defence, and claws were added to teeth as assaulting weapons. Still later, intelligence culminated in man. We have now on earth an epitome of the four methods.

Mr. Redfield accounted for the obscurity of the traces of glacial action in the vicinity of Mt. Desert by the theory that the region had been submerged long enough to remove the striæ from the softer rock.

Oct. 13.—Mr. J. A. Redfield described the topography of Martha's Vineyard and Nantucket in connection with the flora of those islands. The general character of the flora of the central part of the former is much like that on the summit of the divides in Southern New Jersey. In Nantucket many large patches of *Corema conradi* exist, also three species of Erica which seem to be indigenous.

Oct. 20.—A paper by W. N. Lockington called attention to the effects of the compression of strata by superincumbent weight, and suggested that when in a delta vegetable remains were found below the surface of the sea, it might probably be owing to this cause.

Mr. Meehan instanced a case in which the half of the tubers from a pink variety of potato were white, as an example of the spontaneous occurrence of variation.

Oct. 27.—Mr. J. A. Ryder made some remarks upon a new theory which supposed that the original gastrula mouth became elongated into the primitive streak, from the edges of which muscular segments or myotomes were developed. He also called attention to certain embryological peculiarities which evidenced relationship between the Batrachia and the marsipobranchs.

Dr. H. C. Wood gave the results of experiments upon the effect of injecting gastric juice. This produced fever, and it was found that the heat of the body was inverse to the amount of heat given off. Several papers upon fishes were presented for publication.

Nov. 7.—Mr. Redfield stated that the handling of the wild parsnip produced upon a relative of his the same effect as poison ivy.

Mr. Meehan referred to cases of the poisoning of children which seemed traceable to the wild parsnip.

In a discussion upon the change of color in leaves Mr. Meehan remarked that trees brought to America from abroad will, for several years, remain green till the end of the season, but eventually their high vitality will be checked, and the color will commence to change in autumn.

Nov. 10.—Dr. H. Allen called attention to changes in the form of limb bones depending upon the weights they bear. The sloth, bat and seal, different though their habits and limbs are, agree in placing no compression upon the bones of the hinder limb, and in all three the neck of the femur is shortened and its shaft flattened, while the astragalus is lengthened. The direction of the condyles of the femur has constant relation to the weight supported. The effects of suspension were also considered.

Professor Heilprin stated that a second lot of fossils received from the ferruginous sand near Wilkesbarre proved conclusively that the geological horizon is the Upper Carboniferous and not the Permian. The presence of trilobites proves this.

Dr. Leidy stated that Mr. Holman, while studying Amœbæ, had observed one burst and disappear. Very small Amœbæ were afterwards found on the slide. This seems to indicate reproduction by spores as well as by division.

Mr. Willcox stated, as the result of experiment, that the seven-

teen-year locust did not bore in a tree-trunk a separate depository for each egg.

Nov. 24.—Dr. Kœnig announced that the diatoms found in the blue clay bed in the railway cutting near Gray's Ferry road seemed to evidence the Tertiary origin of the clay.

Professor Heilprin called attention to an example of Conorbis from the Oligocene of Florida. It has characters which separate it from other forms, and as it is very large, six inches in length, he proposed the name *princeps*.

Dr. G. H. Horn described a large blind wood-boring beetle from the Colorado desert. It is two inches long and is the largest blind beetle yet known.

Mr. T. D. Rand presented a paper entitled "Notes on the La Fayette Serpentine Belt."

Dec. 3.—Mr. Meehan exhibited seeds of the honey locust of a light-gray or whitish tint. Hybridity could not be the cause, as there is but one species.

Dec. 8.—Mr. E. F. Moody read a paper upon the shoaling of the Delaware opposite Philadelphia. He showed that the Philadelphia channel had shoaled twenty feet in forty years, while the Camden channel had improved. From the increased rapidity of the current on the Camden side, Cooper's point is threatened. It is probable that the river once flowed east of the present site of Camden, Fisher's cove perhaps indicating the commencement of the old channel. A dyke and wall are now building from Fisher's point to the point of Petty's island in order to divert the main current into the Philadelphia channel.

Mr. S. F. Aaron presented a paper on some new Psocidæ.

Dec. 15.—Mr. Morris continued his remarks upon methods of defence in animals, and pointed out that in the otherwise defenceless sponges the size of the exhalent orifices was a defence, while the minuteness of the inhalent orifices gave the sponge greater opportunity for the capture of its microscopic food.

Dec. 22.—Dr. Leidy called attention to the fact that living worms might be contained in ice that is full of air bubbles and water drops. They soon die in the melting water. The little worms found by the speaker seemed to be of an undescribed species, and were named by him *Lumbricus glacialis*.

Mr. C. McCormick described some masses of biotite found in granite at Craftsbury, Vt. They are more or less flattened and elongated, the material being in concentric layers. The cavities in which these inclusions occur are usually lined with biotite.

Jan. 5, 1886.—Dr. Kœnig stated that no less than fifteen genera of diatoms had been found in the blue clay at Gray's Ferry bridge, which was almost as rich in these organisms as the celebrated Richmond earth.

Professor Heilprin gave the name *Saginopteris problematicus* to

a fossil plant which seemed in some respects to resemble a calamite, in others a fern.

Mr. Holstein stated that in certain cultivated portions of Northern Texas streams which once dried up now run during the year. This was referred to the more even absorption of the rainfall consequent on cultivation.

Jan. 19.—Dr. Leidy named *Mastodon floridanus*[1] from certain peculiarities of a last inferior molar, and stated that in a collection recently received from Florida were numerous bones of a rhinoceros, bones apparently indicating three species of llama and an ankle bone of a Megatherium.

Professor Heilprin called attention to fossil shells which indicate the existence of Claiborne beds in San Augustin county, Texas; also to nummulites from Northern Florida.

Feb. 23.—Dr. Leidy described the results of caries in the tooth of *Mastodon floridanus*, and also described a huge hog-like animal from a fragment of a tusk found with the mastodon teeth.

Dr. Rominger presented for publication a paper upon Stromatopora and its allies, and Mr. Chas. Morris another upon the "Phenomena of reversed vision."

THE INDIANA ACADEMY OF SCIENCE held its field meeting at Brookville, May 20 and 21.

Thursday evening, May 20, the Academy was welcomed by D. W. McKee, President of the Brookville Society of Natural History. To this Professor D. S. Jordan, president of the academy, responded. Professor J. C. Branner delivered an address entitled, "The relations now existing between the geologists and the people."

Friday evening, May 21.—Professor D. S. Jordan gave an address on "Darwin," which was discussed by Professor D. W. Dennis. Professor Jordan then spoke on "How to catch fish." Professor Branner gave an account of some methods of collecting corals. Professor P. S. Baker spoke on "The progress of toxicology."

The next meeting of the Academy will be held in Indianapolis in December.

[1] This form has probably been already described in the NATURALIST for 1884 as a variety of *M. angustidens*.—*Ed.*